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PICKERING GS 'B' PREOPERATIONAL BIOLOGICAL STUDY - YEAR II

Report No 82-460-K

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ABSTRACT

Biological, as well as physical and chemical data collected from the nearshore area of Lake Ontario around Pickering GS 'B' in 1980 are presented. These data represent the second year's effort of the Pickering GS 'B' three year preoperational study begun in 1979. The main phytoplankton and zooplankton taxa identified were common plankton of lake Ontario and have been found in previous studies conducted in the study area. Larval tows taken in the Pickering GS 'A' forebay and at the intake of the Scott Water Treatment plant between mid March and late June, produced almost exclusively rainbow smelt larvae. Alewife followed by rainbow smelt was the main fish species netted during the May to November period. Largest number of fish were collected at the Pickering 'A' discharge. During the fall, largest catch per unit effort of whitefish were obtained at Ross Point followed by the Pickering 'B' discharge location.

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PICKERING GS 'B' PREOPERATIONAL BIOLOGICAL STUDY - YEAR II

1.0 INTRODUCTION

The second year of a three-year preoperational biological study was conducted at Pickering GS 'B' between March and December of 1980. The study was requested by the Environmental Studies and Assessments Department of Design and Development Division. This generating station presently under construction is a nuclear power station which when completed will have four CANDU powered 540 MW units. The projected reactor critical dates of the units are scheduled as follows: Unit 5 - October 1, 1982, Unit 6 - September 1, 1983, Unit 7 - March 1, 1984, and Unit 8 - September 1, 1984. The projected in-service dates for units 5 and 6 are scheduled for April 1, 1983 and April 1, 1984 respectively and the in-service dates for units 7 and 8 are scheduled for September 1, 1984 and February 1, 1985.

Pickering GS 'B' is located adjacent to Pickering GS 'A' which is also a four unit (units 1-4) nuclear powered generating station. The two stations have a common surface intake for their condenser cooling water system but have separate discharges. Pickering 'A' discharges its cooling water to the west of the stations while Pickering 'B' will discharge to the east of the stations. In addition, Pickering 'B' has a discharge tempering system designed for it which Pickering 'A' does not.

During the 1980 sampling program all four units of Pickering 'A' were out of service for vacuum building testing from May 14 to May 29 inclusive. The outage period for the individual units were as follows: Unit 1 - May 14 to May 29, Unit 2 - May 12 to July 8, Unit 3 - May 9 to June 6, and Unit 4 - May 14 to May 30.

1.1 Objective

The objective of the Pickering GS 'B' three year preoperational study is to describe the biota of Lake Ontario in the vicinity of the station in adequate detail such that possible effects of the future operation of Pickering 'B' can be detected when comparisons are made with postoperational data.

1.2 Scope

As in the first year of this study, in the second year we were primarily concerned with the spatial distribution of the aquatic flora and fauna in the study area. In the first and third year of the three year study attached algae, phytoplankton, zooplankton, zoobenthos, larval, juvenile and adult fish and waterfowl were studied. Attached algae, zoobenthos and waterfowl were not studied in the second year. To supplement the biological data some physical and chemical parameters were also monitored. Physical characteristics studied were: sedimentation, water temperature and water transparency. Sampling was conducted from March to December, 1980. The sampling schedule is summarized in Table 1.2-1.

TABLE 1.2-1

Sampling Schedule Summary
Pickering 'B' Preoperational Study
Year II, 1980

	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Sample Type										
Sedimentation			X	———	———	X	———	———	X	
Water Quality			X		X		X		X	
Phytoplankton			X	X						
Zooplankton			X	X						
Fish - Larvae	X	X	X	X						
- Juveniles and Adults			X	X	X	X	X	X	X	X
- Whitefish Study									XX	XX

1.3 Study Area

The study area included a 5.5 km stretch of shoreline from Frenchman Bay to Simcoe Point (Figure 1.3-1). The plankton sampling points were located on 12 transects (D to 0) running perpendicular to shore and spaced 500 m apart. Two additional transects located in the Pickering 'A' discharge and at the

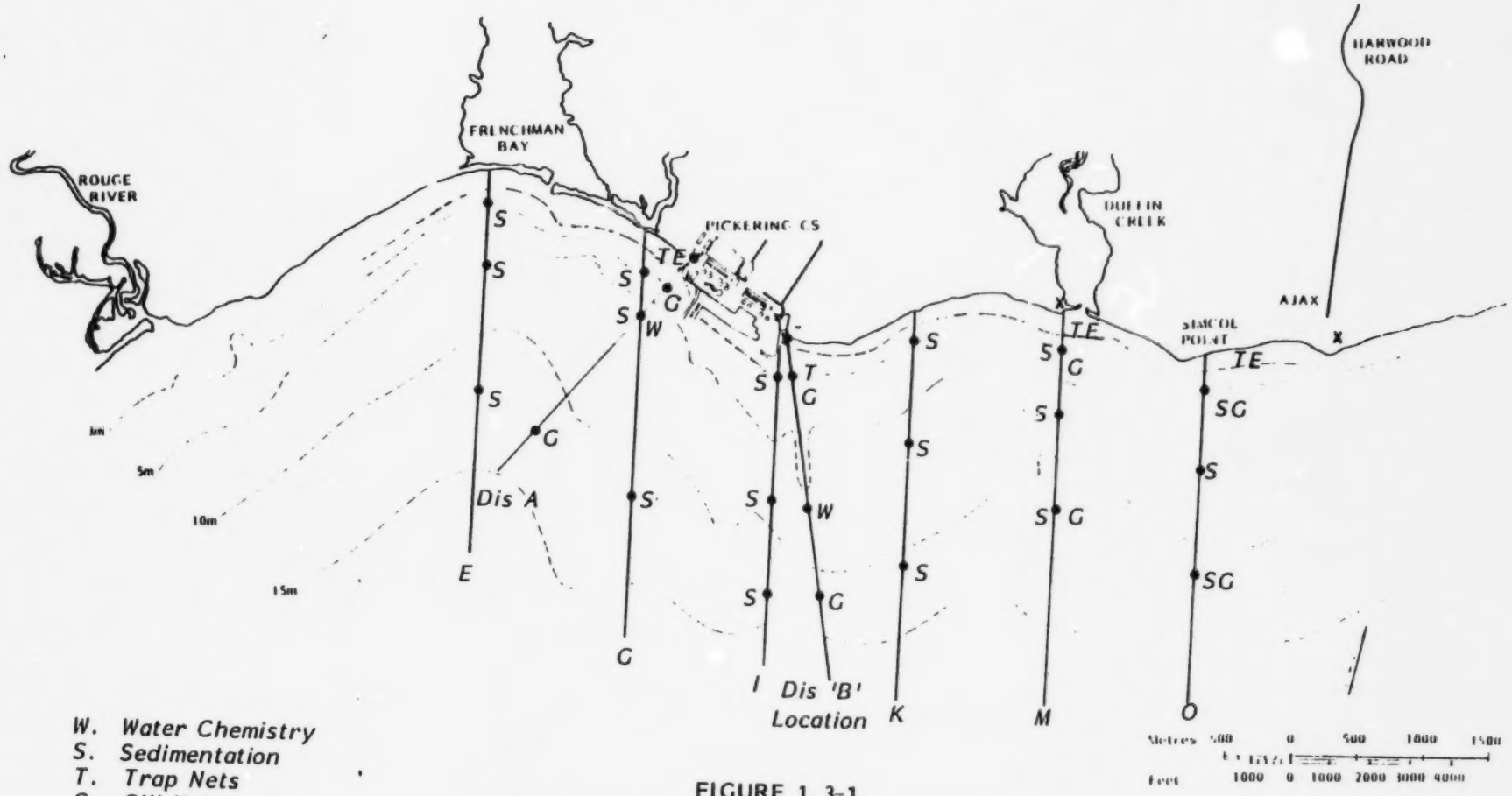

FIGURE 1.3-1
PICKERING GS 'B' SITE MAP, LAKE ONTARIO - 1980

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Pickering 'B' discharge location, previously sampled during the Pickering 'A' survey (Ontario Hydro Research Division Report No 80-226-K) were also included. Sampling locations for the various parameters monitored are shown in Figures 1.3-1 and 1.3-2.

2.0 METHODS

2.1 Physical Characteristics

2.1.1 Sedimentation

Sets of four sediment tubes (inner diameter = 5.1 cm, height = 63 cm) were placed at the 3, 7 and 12 m depths on transects E, G, I, K, M and O, and were left for two three-month intervals: May 15 to August 12, and August 12 to November 26, 1980. The sediment traps placed at the 3 m depth on all transects and at the 12 m depth on transect E on August 12 were lost due to inclement weather. Consequently sedimentation data for these locations are not available for the second sampling period. The sediment traps were retreived by SCUBA equipped divers who capped the tubes prior to recovery. Samples were preserved by freezing. Following a thawing and settling period, the contents of the tubes were oven dried at 105 C to constant weight and ashed at 525 C to determine the organic content.

2.1.2 Mean Daily Temperature

Mean daily temperatures presented were obtained from the Hydraulic Studies Department of Design and Development Division. Mean daily temperatures are presented for the 3 m locations in the Pickering 'A' discharge (Hydraulic Studies and Development Department, location TH66) and Pickering 'B' (Hydraulic Studies and Development Department, location THB01) discharge location as well as at 5 m in the Pickering 'A' forebay (Hydraulic Studies Department, location TH11).

2.1.3 Vertical Temperature Profiles and Water Transparency

Temperature profile data and water transparency in terms of secchi depth, were collected by Hydraulic Studies Department 1.4 km offshore along the Pickering 'B' discharge location transect.

2.2 Water Quality

Water samples for chemical analysis were collected at the mouth of the intake channel and the 7 m (depth) spars along the Pickering 'A' and 'B' discharge transects on May 23, July 23, September 13 and November 3, 1980, with a Van Dorn bottle and were preserved according to instructions in OHRD Report No 78-285-k. The samples were analyzed by the Analytic Services section of the Research Division. Analytical procedures used are described in Appendix 1.

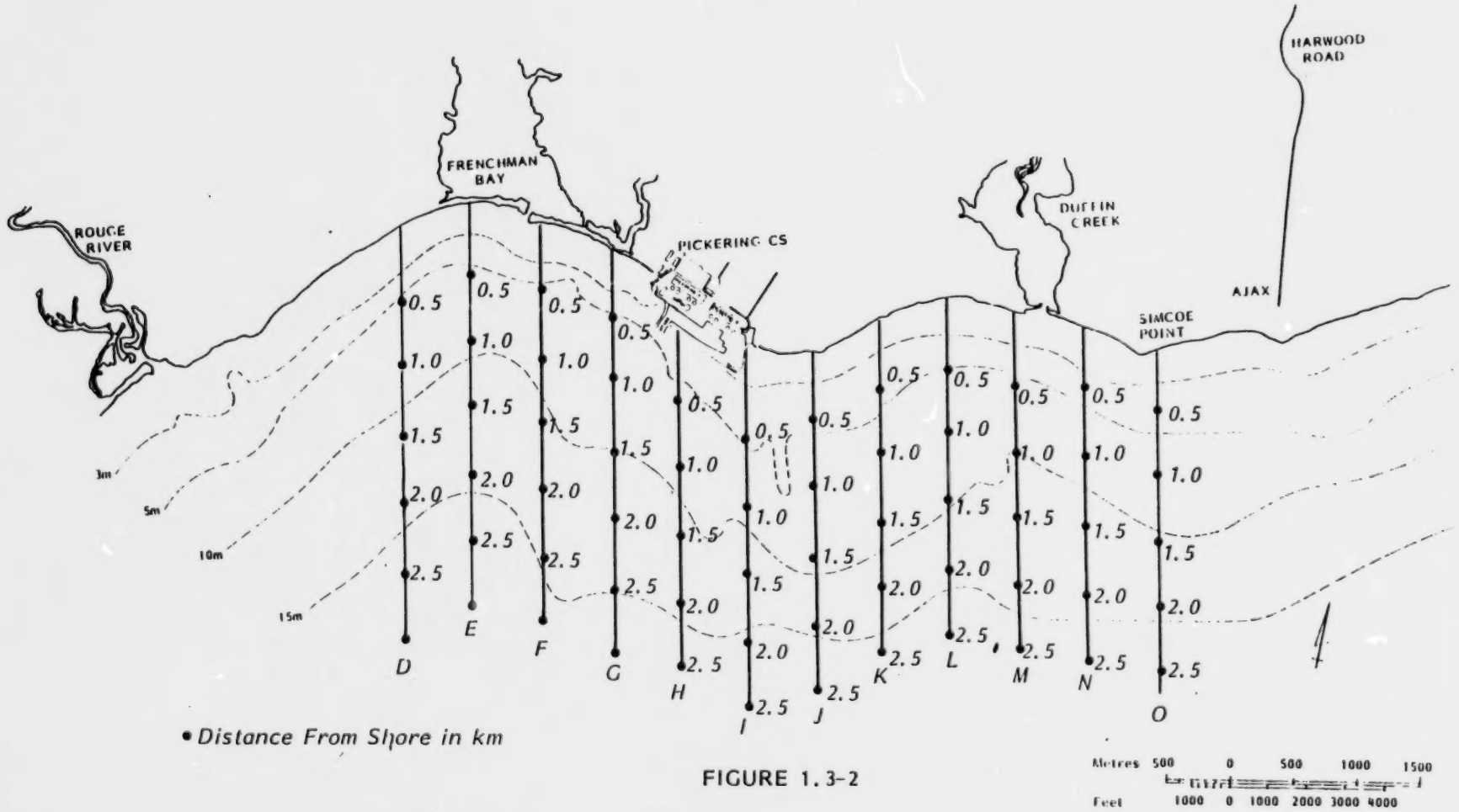

FIGURE 1.3-2

PLANKTON SAMPLING LOCATIONS, LAKE ONTARIO AT PICKERING GS 'B' 1980

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2.3 Phytoplankton

Phytoplankton samples were collected on May 27 and on June 12. On the former date all four units of Pickering GS 'A' were out of operation while on the latter date three out of the four units were back in operation. During the outage period only one CCW pump per unit was running. Samples from the surface 3 m of the water column were collected at points 0.5, 1.0, 1.5, 2.0, and 2.5 km from shore along transects D, E, F, G, H, I, J, K, L, M, N, and O with a 3 m integrated tube. Each set of 60 samples were collected within six hours. The samples were preserved in Lugol's Iodine solution. Data are presented as biomass estimates in mg m^{-3}.

Each time a set of grid samples were collected, three samples were taken at spar K 2 so that an estimate of sampling error could be obtained (Appendix II). The standard deviations of the taxa were calculated and multiples of the standard deviation were then used to establish density categories which were plotted on a map of the study area.

In the first year of the Pickering 'B' preoperational study phytoplankton samples were collected at 1 m depth with a Van Dorn bottle. However, to obtain data directly comparable with the Pickering 'A' data which were collected with a 3 m integrated tube, the samples in 1980 were also collected with a 3 m integrated tube. Comparisons of samples (5 replicates) collected with both samplers at 0.5, 1.5 and 2.5 km offshore on transect K indicated no significant differences between the two sampling techniques (Appendix III).

2.4 Zookplankton

Zooplankton were collected at the same locations and times as the phytoplankton samples. Samples consisted of two hauls taken with a 27 l Schindler-Patalas trap equipped with a 64 µm mesh net. Hauls were made at the 1 m depth (sub-surface) and were preserved in 10% alcohol in the field which was replaced with 10% formalin in the laboratory.

As with the phytoplankton, three samples were taken at spar K 2 each time a set of samples were taken to obtain estimates of sampling error (Appendix II). Density distribution maps were then plotted taking into account the standard deviations.

2.5 Fish

Larval fish were collected from the Pickering 'A' intake forebay and at the Scott Water Treatment Plant intake pipe. Three day samples (1600 h) and three night samples (200 h) were taken weekly at each location with a 0.5 m (diameter) 361 µm mesh conical net from mid march to the end of June. For each sample the nets equipped with flow meters were suspended in the water for a 5 minute filtering period. Individual flowmeter readings were used to calculate larval fish densities.

A variety of methods were used to sample fish representative of the various habitats of the nearshore zone. Fish were collected monthly from May to November by beach seines, trap nets and gill nets. Gill netting could not be carried out in December as proposed due to severe weather and ice conditions. Locations fished were the mouth of the Rouge River, the Pickering 'A' discharge, the Pickering 'B' discharge location, the mouth of Duffin Creek and Simcoe Point. Three beach seine hauls were made monthly nearshore at each location. Pairs of 1.2 m trap nets were set for two consecutive nights per month at the 3 m depth in each area. Sets of experimental gill nets were set for two consecutive nights per month at each location. Nets were set perpendicular to shore, one at the 3-5 m depth and a second at the 12-15 m depth. An experimental gill net consists of nine 15 m panels with mesh size ranging from 2.5 to 12.5 cm in 1.25 cm increments. Catch per unit effort (CUE) was calculated for the abundant species as number of individuals per beach seine, trap net or gill net (shallow and deep set) haul for individual sampling periods.

2.6 Whitefish Survey

To determine the distribution of round whitefish along the northshore of Lake Ontario, gill nets were set between Pickering GS 'A' and Ross Point, just east of Whitby Harbour while the Ministry of Natural Resources fished the area around Darlington (Haymes and Kolenosky, 1982).

Nets were set on the bottom perpendicular to shore with the inshore end in 3-5 m of water at the locations listed in Table 2.6-1. Ontario Hydro gill nets were set at each of Pickering GS 'A', Pickering GS 'B', Duffin Creek, Simcoe Point and Richardson Point while Ontario Hydro nets and Ministry of Natural Resources nets were alternated at Whitby west (Point 1.5 km west of Whitby Harbour) and Ross Point. This was done as only Ministry of Natural Resources nets were used to the east of Ross Point.

To compare the efficiency of the MNR nets and those of Ontario Hydro, one Ontario Hydro net and one MNR net were set in sequence or on alternate days, parallel to shore along the 5 m contour at Frenchman Bay. The basic difference between MNR and Ontario Hydro nets is the length of the panels, the former being comprised of 50 yd panels and the latter being comprised of 50 ft panels.

Although some nets contained 1.5 and 2 inch meshes the data was analyzed based on 2.5 to 5.0 inch mesh in 0.5 inch increments to maintain consistency with earlier studies.

All sets were 24 hours in duration and fished on the dates listed in Table 2.6-1.

Trap nets (1.2 m) were set in the Rouge River, Duffin Creek and Wilmot Creek to determine whether round whitefish moved up these

tributaries to spawn. Despite a minimum of ten, 24-hour sets, no round whitefish were caught and thus will not be discussed further.

Round whitefish caught in gill nets were measured, sexed, and their reproductive condition was noted. Scales were collected and aged by both the Ministry of Natural Resources and Ontario Hydro.

TABLE 2.6-1

LOCATION AND DATES OF GILL NET SETS DURING WHITEFISH STUDY

Location	Date							
	November				December			
	19	20	25	26	2	5	9	10
Pickering GS 'A'	✓	✓	✓	✓	✓	✓	✓	✓
Pickering GS 'B'	✓	✓	✓	✓	✓	✓	✓	✓
Duffin Creek	✓	✓	✓	✓	✓	✓	✓	✓
Simcoe Point	✓	✓	✓	✓	✓	✓	✓	✓
Richardson Point	✓	✓	✓	✓	✓	✓	✓	✓
Whitby West	X	✓	X	✓	X	✓	X	X
Frenchman's Bay[1]	✓	✓X		✓		X	✓	X
Thickson Point	X	✓	X	✓	✓	X	X	✓

✓ Ontario Hydro Nets

X Ministry of Natural Resources Nets

1 Set parallel to shore

3.0 RESULTS

3.1 Physical Characteristics

3.1.1 Sedimentation

The mean dry weight, ash weight, organic weight and per cent organic content of sediment collected in traps during the summer (May 15 to August 12) and fall (August 12 to November 26) are presented in Table 3.1.1-1. The rates of sediment accumulation (sedimentation) in grams of dry weight per cm^2 per month (30 days) at the various locations are presented in Table 3.1.1-2. Sedimentation discussed in this section does not represent net sedimentation rate since the traps preclude resuspension of the sediment.

TABLE 3.1.1-1

MEAN DRY WEIGHT (g/cm^2), ASH WEIGHT (g/cm^2) AND ORGANIC WEIGHT (g/cm^2) OF SEDIMENT COLLECTED IN TUBES FROM MAY 15 TO AUGUST 12, AND AUGUST 12 TO NOVEMBER 26, 1980, IN LAKE ONTARIO AT PICKERING GS "B"

		May 15 - August 12					
Depth (m)		E Frenchman Bay	G Pickering "A" Discharge Area	I Pickering " " Discharge	K 1 km East of Pickering "B"	M Duffin Creek	O Simcoe Point
3	Mean Dry Weight	0.31	0.58	0.44	0.56	0.45	0.81
	Ash Weight	0.27	0.54	0.40	0.40	0.42	0.80
	Organic Weight	0.04	0.04	0.04	0.16	0.03	0.01
	% Organic Content	12.9	6.9	9.1	28.6	6.7	1.2
7	Mean Dry Weight	0.47	0.20	0.13	0.35	0.25	0.24
	Ash Weight	0.45	0.18	0.11	0.34	0.23	0.21
	Organic Weight	0.02	0.02	0.02	0.01	0.02	0.03
	% Organic Content	4.3	10.0	15.4	2.9	8.0	12.5
12	Mean Dry Weight	0.11	0.12	0.09	0.14	0.14	0.10
	Ash Weight	0.10	0.11	0.08	0.13	0.12	0.09
	Organic Weight	0.01	0.01	0.01	0.01	0.02	0.01
	% Organic Content	9.1	8.3	11.1	7.1	14.3	10.0

		August 12 - November 26					
Depth (m)		E Frenchman Bay	G Pickering "A" Discharge Area	I Pickering " " Discharge	K 1 km East of Pickering "B"	M Duffin Creek	O Simcoe Point
3	Mean Dry Weight Ash Weight Organic Weight % Organic Content	(Samples Lost)					
7	Mean Dry Weight	1.63	2.08	1.26	0.67	4.89	2.22
	Ash Weight	1.53	1.96	1.22	0.62	4.64	2.10
	Organic Weight	0.10	0.12	0.04	0.05	0.25	0.12
	% Organic Content	6.1	5.8	3.2	7.3	5.11	5.4
12	Mean Dry Weight	(Sample Lost)	0.98	0.55	1.29	2.29	0.63
	Ash Weight		0.89	0.51	1.18	2.15	0.57
	Organic Weight		0.09	0.04	0.11	0.14	0.06
	% Organic Content		9.2	7.3	8.5	6.1	9.5

TABLE 3.1.1-2

RATE OF SEDIMENT ACCUMULATION IN TRAPS (g Dry Weight/cm^2/month) BETWEEN MAY 15 AND AUGUST 12, AND BETWEEN AUGUST 12 AND NOVEMBER 26, 1980 IN LAKE ONTARIO AROUND PICKERING GS 'B'

	May 15 - August 12 g Dry Weight/cm^2/month					
Transect	E	G	I	K	M	O
Depth (m)						
3	0.11	0.19	0.15	0.19	0.15	0.28
7	0.16	0.07	0.04	0.12	0.09	0.08
12	0.04	0.04	0.03	0.05	0.05	0.03
	August 12 - November 26 g Dry Weight/cm^2/month					
Transect	E	G	I	K	M	O
Depth (m)						
3			(Samples lost)			
7	0.46	0.59	0.36	0.19	1.39	0.63
12	(Sample lost)	0.28	0.16	0.37	0.65	0.18

During the summer period sedimentation was highest at the 3 m depth and lowest at the 12 m depth along all transects except transect E at Frenchman Bay where the largest amount of sediment was collected at 7 m. Sedimentation along the 3 m depth contour was lowest on transect E (0.11 g dry wt/cm^2/month) and highest on transect O at Simcoe Point (0.28 g dry wt/cm^2/month). Along the 7 m depth contour sedimentation was highest on transect E (0.16 g dry wt/cm^2/month) and lowest on transect I around the Pickering 'B' discharge location (0.04 g dry wt/cm^2/month).

Sedimentation along the 12 m depth contour did not vary much and ranged between 0.03 (Transects I and O) and 0.05 g dry wt/cm^2/month (transect K and M, 1 km east of Pickering 'B' and Duffin Creek, respectively). Higher amounts of organic material were collected at the 3 m depth than at 7 and 12 m. The organic portion of the 3 m sediment samples ranged between 0.01 and 0.16 g/cm^2 with highest amounts collected on transect K and lowest amount collected on transect O. The organic content as a percentage of the total amount of sediment (dry weight) collected was 29% at the former location and 1.2% at the latter. The amount of organic material trapped at the spars on the 7 and 12 m depth contours did not vary much. At 7 m it ranged between 0.01 g/cm^2 on transect K and 0.03 g/cm^2 on transect O. At these locations the per cent organic content was 2.9 and 12.5% respectively. At 12 m the amount of organic material trapped was 0.01 g/cm^2 on all transects except M where an accumulation of 0.02 g organic material/cm^2 was found. Organic content at the 12 m locations varied between 7.1% found on transect K and 14.3% on transect M.

The sediment traps placed at all 3 m locations and at 12 m on transect E on August 12 were lost due to inclement weather and sedimentation data for these locations are therefore, not available for the fall period. Along the 7 and 12 m depth contours sedimentation during the fall ranged from 0.19 to 1.39 g dry wt/cm^2/month and 0.16 to 0.65 g dry wt/cm^2/month respectively. Sedimentation was highest on transect M at both depths. The amount of organic material collected at 7 m was between 0.04 and 0.25 g/cm^2 and at 12 m it was between 0.04 and 0.14 g/cm^2. At both depths the largest amounts of organic material was collected on transect M. The per cent organic content of the 12 m samples were higher than that of the 7 m samples. At 7 m the per cent organic content ranged from 3.2 (Transect I) to 7.5% (Transect K) and at 12 m it was between 6.1 (Transect M) and 9.5% (Transect O).

Sedimentation as well as the amount of organic material trapped were higher during the fall period than during the summer period.

The amount of sediment collected during the summer period was generally slightly lower than the amounts collected in the summer of 1979. While fall values were comparable to those collected in the fall of 1979.

3.1.2 Mean Daily Temperatures

Mean daily temperatures monitored in the Pickering 'A' forebay indicated a gradual warming of the water between the first week of April and the third week in July (Figure 3.1.2-1). The mean daily temperature then increased rapidly from about 7.0 C to 19.0 C. Mean daily temperatures were highest from the last week of August through the first week of September. Maximum mean daily temperature during this period was 21.7 C found on August 31. Major upwellings characterized by sudden large drops in temperature, occurred in mid August and in the second week of September. During the August upwelling the water temperature dropped down to 10.6 C and during the September upwelling it reached a low of 6.2 C. Mean daily temperatures declined sharply in September from about 15.2 C to 6.9 C. Temperatures remained low and declined gradually for the remainder of the year. Mean daily temperatures monitored in the Pickering 'B' discharge (3 m depth) showed similar temperatures and trends as those observed in the Pickering 'A' forebay (Figure 3.1.2-1).

Mean monthly temperature was highest in August (Table 3.1.2-1) in both the Pickering 'A' forebay and the Pickering 'B' discharge (17.6 and 17.7 C respectively). The mean monthly delta T between the Pickering 'A' discharge and intake forebay ranged from 4.4 C in May to 11.3 C in October. The low mean monthly delta T obtained in May was due to the absence of a thermal discharge during the plant outage period that lasted from May 14 to 29 (Figure 3.1.2-1).

3.1.3 Vertical Temperature Profiles and Water Transparency

During the May to September period thermal gradients (Figure 3.1.3-2) between surface and bottom temperatures at a spar 1.4 km offshore (maximum depth 14 m) along the Pickering 'B' discharge transect ranged from 1.1 C on June 10 to 7.9 C on July 22. Between May and December, surface temperatures ranged between 4.0 C in December to 18.1 C in September, while bottom temperatures ranged from 4.0 C in December to 13.2 C in August. On November 11 and December 4 unithermal conditions (approximately 4 C) persisted. The largest degree of thermal stratification was found on July 22 when some development of a thermocline was noticeable between the 4-6 m depth.

Water transparency in terms of Secchi depth ranged from 2.0 to 6.0 m with lowest transparency found on July 22 and highest transparency found on September 30.

3.2 Water Quality

Water quality data are presented in Table 3.2-1. Water samples were collected for analysis on May 23, July 23, September 23 and November 3, 1980, at the mouth of the intake channel and at the 7 m spars in the Pickering 'A' discharge and Pickering 'B' discharge location.

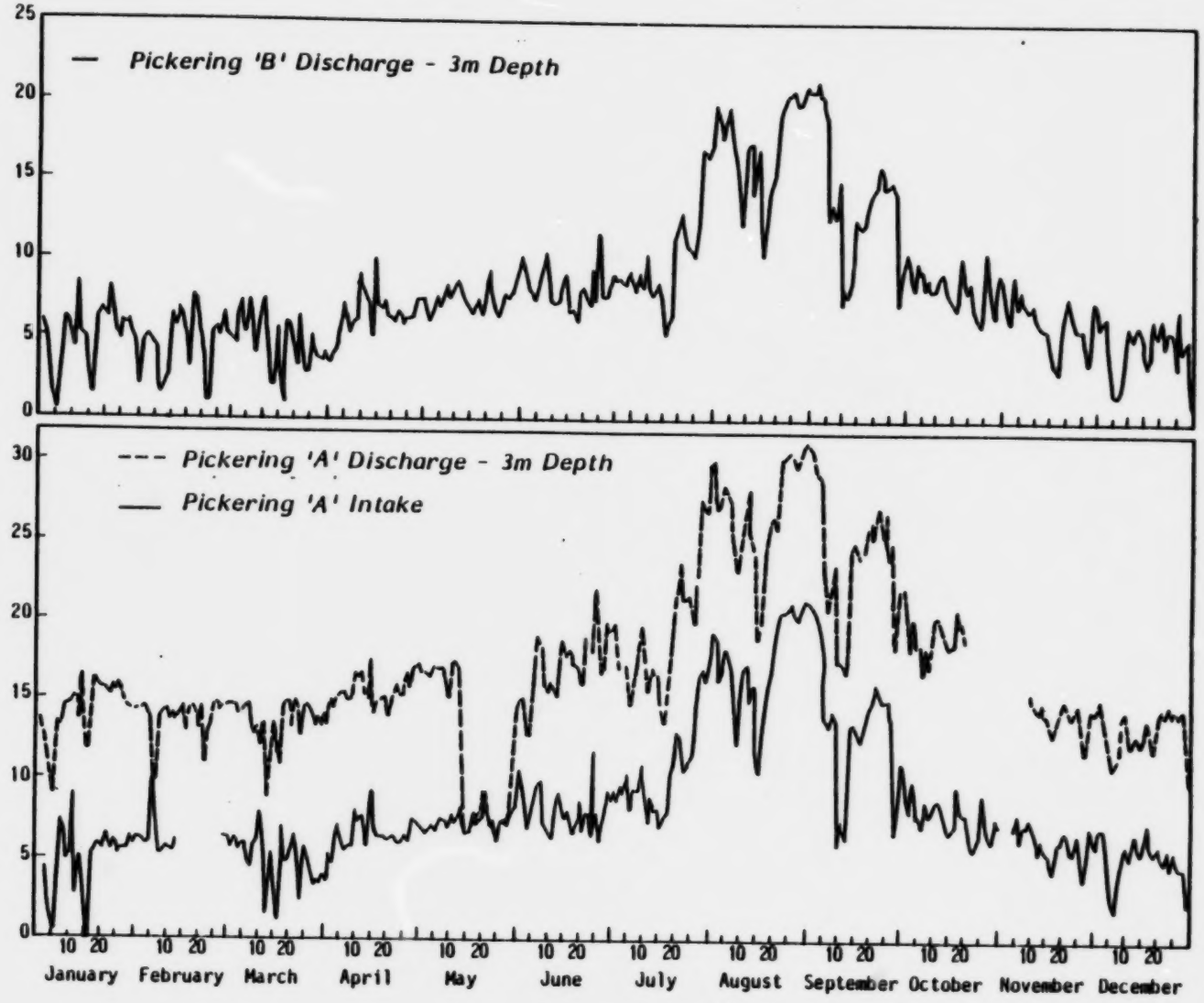


FIGURE 3.1.2-1

MEAN DAILY TEMPERATURES IN THE PICKERING 'A' DISCHARGE, PICKERING 'B' DISCHARGE LOCATION AND PICKERING 'A' INTAKE FOREBAY, LAKE ONTARIO, JANUARY-DECEMBER, 1980

154206 RD
82-460

TABLE 3.1.2-1

MEAN MONTHLY TEMPERATURES (°C) AT THE 3 METRE DEPTHS IN THE PICKERING "A" DISCHARGE AND "B" DISCHARGE LOCATIONS AND AT 5 METRES IN THE PICKERING "A" INTAKE FOREBAY AND MEAN MONTHLY ΔT BETWEEN PICKERING "A" INTAKE AND DISCHARGE, JANUARY - DECEMBER, 1980

	Pickering GS 'B' Discharge - 3 m	Pickering GS 'A' Discharge - 3 m	Pickering GS 'A' Intake - 5 m	ΔT Between Pickering 'A' Intake and Discharge
January	4.8	14.1	5.0	9.1
February	4.7	13.8	5.2[1]	8.6
March	4.9	13.7	4.8	8.9
April	6.7	15.6	6.5	9.1
May	7.7	11.9	7.5	4.4
June	8.5	17.2	8.2	9.0
July	10.7	19.5	10.9	8.6
August	17.7	27.3	17.6	9.7
September	13.9	24.2	13.9	10.3
October	8.6	19.3[2]	8.0	11.3
November	6.4	15.1[3]	5.2	9.9
December	4.8	13.4	5.3	8.1

[1]Feb 15-27 missing

[2]Oct 22-31 missing

[3]Nov 1-9 missing

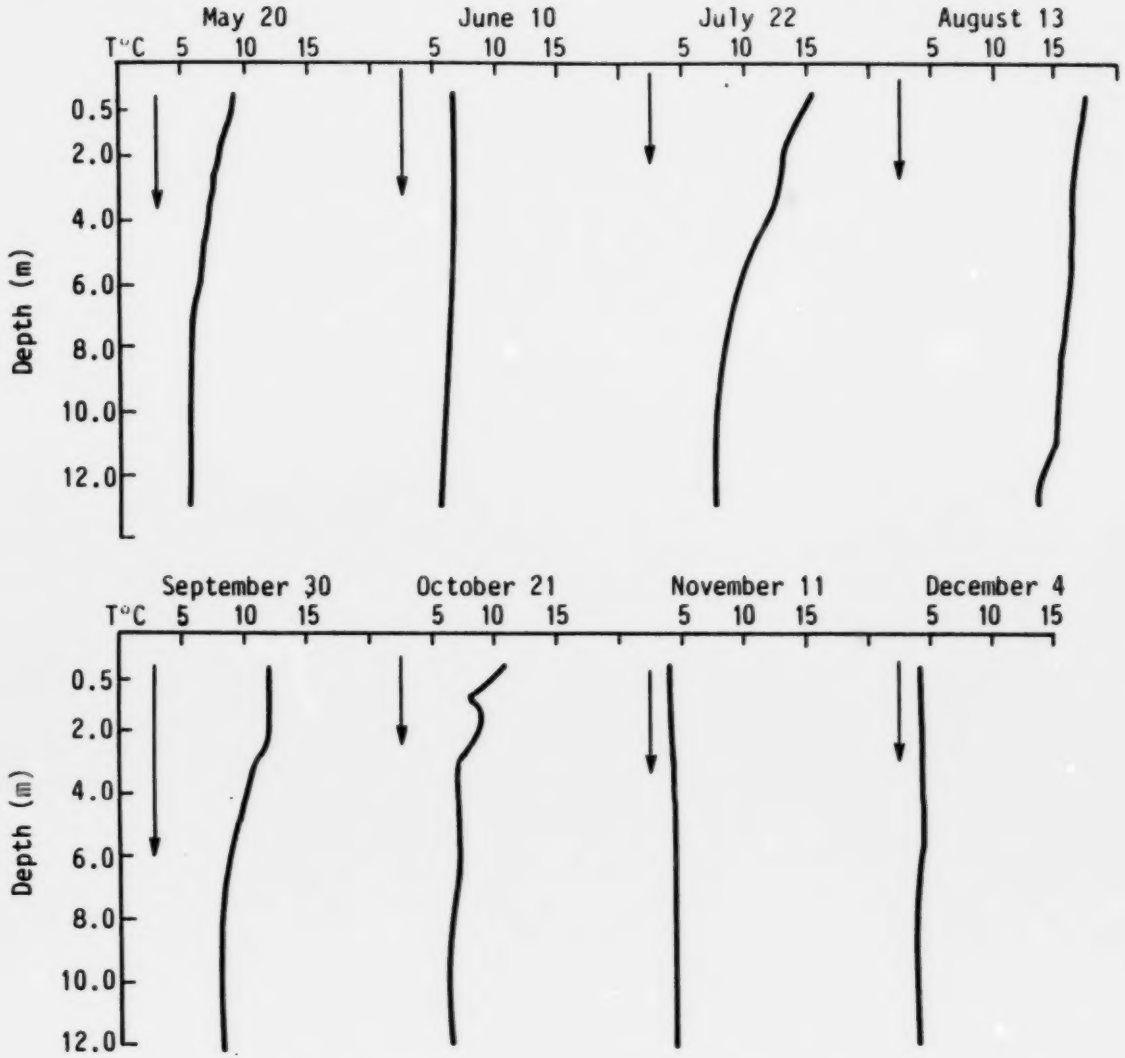


FIGURE 3.1.3-2

VERTICAL TEMPERATURE PROFILE AND SECCHI DEPTH (↓) AT 1.4 km OFFSHORE LOCATION ALONG PICKERING GS 'B' DISCHARGE LOCATION TRANSECT, LAKE ONTARIO, MAY TO DECEMBER 1980

82-460 154217 RD

TABLE 3.2-1

WATER QUALITY PARAMETERS OF SAMPLES COLLECTED WITH A VAN DORN BOTTLE
AT THE MOUTH OF THE INTAKE CHANNEL AND THE 7 METRE SPARS
IN THE PICKERING "A" DISCHARGE AREA AND PICKERING "B" DISCHARGE LOCATION
PICKERING GS "B" - 1980

		MAY 23			JULY 23			SEPTEMBER 23			NOVEMBER 3		
			Disch "A"	Disch "B"		Disch "A"	Disch "B"		Disch "A"	Disch "B"		Disch "A"	Disch "B"
Parameter	Unit	Intake	-7m	-7m	Intake	-7m	-7m	Intake	-7m	-7m	Intake	-7m	-7m
Colour		None	None	None	None	None	None	None	None	None	None	None	None
Conductivity	mS/m	33.0	32.6	32.5	33.2	33.4	35.5	30.5	30.0	30.1	35.6	32.1	32.0
Turbidity	NTU	1.7	1.8	2.2	1.4	1.6	1.8	1.5	1.4	1.3	2.0	1.8	1.0
Suspended Solids - dry	mg/L	2.2	3.2	5.2	3.0	3.6	3.2	2.2	1.2	1.0	3.4	1.6	1.6
- ash	mg/L	0.8	1.8	1.8	0.8	1.4	1.0	<1.0	<1.0	<1.0	2.6	1.0	1.2
Dissolved Solids - dry	mg/L	216	212	215	209	210	206	204	201	204	216	208	199
- ash	mg/L	170	168	172	172	168	172	154	162	152	174	167	159
pH		8.5	8.6	8.5	8.5	8.5	8.5	8.3	8.3	8.3	8.1	8.1	8.1
Chemical Oxygen Demand	mg/L	9	7	7	14	12	16	7	4	7	5	5	6
Biological Oxygen Demand	mg/L	1	1	1	1.7	1.1	1.3	1	1	2	2.2	1.4	2.2

Differences in the levels of the water quality parameters monitored were generally seasonal rather than spatial. Apparent color, which is associated with the presence of humic acid was not detected in any of the samples. Specific conductance, a measure of the total amount of ionized material in water, ranged between 30.0 and 35.6 mS/m (milliseimens/meter). Lowest specific conductance was found on September 23 at all three locations. On this date a specific conductance of 30.5 mg/m was registered in the intake, and 30.0 and 30.1 mg/m in the Pickering 'A' and Pickering 'B' discharges, respectively. Rivers and lakes in Ontario, free of industrial waste, normally have dissolved solids concentration equal to 0.65 + 0.10 times the specific conductance of the water in micromhos/cm (MOE, 1975). The concentration of dissolved solids (dry wt) on four sampling dates did not vary much spatially or seasonally and ranged from 199 - 216 mg/L. These concentrations were between 0.58 and 0.68 times the conductivity of the samples. Lowest dissolved solids concentration levels were also found in September when dissolved concentrations were 204, 201 and 204 mg/L in the intake, Pickering 'A' discharge and Pickering 'B' discharge location, respectively. The organic portion of the dissolved solids ranged between 16.5 and 25.5% which was approximately similar to the 1979 organic content found for the dissolved solids during the first year of the pre-operational study in 1979. Highest organic content was found for the dissolved solids in the September 23 samples collected in the Pickering 'A' discharge location and at the Pickering GS 'B' discharge location. On this day the organic content estimated for the dissolved solids in the Pickering 'A' discharge and Pickering 'B' discharge samples were 24.5 and 25.5%, respectively. Levels of suspended solids ranged between 1.0 and 5.2 mg/L with lowest levels also found in September. Organic content of the suspended solids could not be calculated for September 23 since the ashed weight was below the detection level. On the remaining sampling dates lowest mean organic content of suspended solids was found on November 3 (28%) and highest was estimated on July 23 (73%).

No seasonal or spatial trends were apparent in the turbidity of the water which ranged between 1.0 and 2.2 NTU. The pH indicated slightly alkaline water and ranged from 8.1 to 8.6. Chemical oxygen demand ranged from 2 to 16 mg/L with highest demand at all locations found on July 23. Biological oxygen demand, a measure of the dissolved oxygen required for the aerobic bacterial stabilization of decomposable organic matter in a five-day period, ranged between 1 and 4 mg/L with lowest demand on September 23 and highest demand on July 23. On September 23 the BOD was 1, 1, and 2 mg/L at the intake, the Pickering 'A' discharge and Pickering 'B' discharge location, respectively. On July 23 the BOD at the above locations was 3.7, 3.1 and 3.3 mg/L.

3.3 Phytoplankton

Phytoplankton samples were collected on May 27, 1980 during a Pickering GS 'A' plant outage period which lasted from May 14 to May 29, and again on June 12 when the plant was back in operation. Complete phytoplankton data for these two dates are presented in Appendix IV. The mean densities (mg m^{-3}) and relative abundances of the phytoplankton present on May 27 and June 12 are presented in Table 3.3-1.

In terms of biomass the diatoms (Baccilariophyta) dominated the phytoplankton and the flagellates (Pyrrophyta) were the second most prominent group present in the surface to 3 m strata on both sampling dates. The main phytoplankter present in the study area on May 27 was the diatom *Stephanodiscus binderanus*. It made up 46% of the total phytoplankton biomass and its mean density was 743 mg m^{-3}. *Melosira granulata*, also a diatom, was the second most abundant taxon present and contributed to 35% of the total biomass with a mean density of 558 mg m^{-3}. Cryptomonas was the main flagellate present. It represented 4% of the total biomass and its mean density was 57 mg m^{-3}. Mean total phytoplankton biomass was estimated to be 1606 mg m^{-3}. The high phytoplankton density found on May 27 was probably part of the spring diatom increase.

On June 12 *M. granulata* was the main phytoplankter present representing 34% of the total biomass. Its density was down from the previous sampling date to 215 mg m^{-3}. *Cryptomonas* was the main flagellate and second most abundant phytoplankton taxon present. It contributed to 23% of the total biomass and its density was up from the previous sampling date to 142 mg m^{-3}. The diatom *Diatoma* was also prominent on this day representing 14% of the total biomass. Its density was 91 mg m^{-3} which was higher than it had been on May 27. The mean total phytoplankton biomass on June 12 was 631 mg m^{-3}, considerably lower than it had been on May 27.

Stephanodiscus binderanus (= Melosira binderana), the dominant phytoplankton taxon found on May 27 was described by Munawar and Nauwerck (1971) as the most important spring species in Lake Ontario and as representing the major part of the diatom volume. *Melosira granulata* was recorded for Lake Ontario by Reinwand (1969) and Sreenivasa and Nalewajko (1975). Both studies indicated that the occurrence of *M. granulata* in Lake Ontario was sparse and that *M. islindica* was the more widespread form. Cells identified as *M. granulata* in our samples possibly includes forms of *M islindica*. Hutchinson (1967) describes *M. granulata* as widespread in eutrophic lakes occurring mainly in the summer. *Cryptomonas erosa* was among a group of phytoplankton described by Munawar and Nauwerck (1971) as prominent perennial species in Lake Ontario.

TABLE 3.3-1

Densities (mgm^{-3}) and Relative Abundance (%) of Phytoplankton Collected in Lake Ontario Around Pickering GS 'B' on May 27 and June 12, 1980

Taxon	May 27		June 12	
	mgm^{-3}	%	mgm^{-3}	%
Cyanophyta - total	5.5		1.4	
Anabaena sp	0.3	<0.1		
Aphanizomenon flos-aquae	1.4	0.1	1.2	0.2
Chroococcus sp	0.8	0.1		
Oscillatoria spp	0.3	<0.1	0.2	<0.1
Chlorophyta - total	12.1		5.5	
Actinastrum sp	0.3	<0.1	0.2	<0.1
Ankistrodesmus falcatus	4.0	0.3	1.7	0.3
A. falcatus v. mirabilis	1.0	0.1	0.2	<0.1
Cosmarium sp	1.3	0.1	0.2	<0.1
Elakatothrix gelitonosa	0.3	<0.1	0.1	<0.1
Lagerheima sp	<0.1	<0.1		
Oocystis sp	<0.1	<0.1		
Pediastrum sp			0.1	<0.1
Scenedesmus bijuga	4.4	0.3	3.0	0.5
S. quadricauda	0.1	<0.1	<0.1	<0.1
Selenestrum sp	0.1	<0.1	<0.1	<0.1
Staurastrum sp	0.6	<0.1	<0.1	<0.1
Pyrrophyta - total	128.6		189.3	
Peridinium sp	31.3	2.0	14.9	2.4
Cryptomonas sp	57.4	3.6	141.5	22.5
Rhodomonas minuta	29.9	1.9	32.7	5.2
unidentified cryptophyceae			0.2	<0.1
Chrysophyta - total	0.8		1.5	
Dinobryon sociale	0.8	0.1	1.4	0.2
Dinobryon sp			0.1	<0.2
Baccilariophyta - total	1472.5		433.1	
Achnanthes sp			<0.1	<0.1
Amphora			0.1	<0.1
Asterionella gracillima	19.0	1.2	6.2	1.0
Cocconeis sp	0.4	<0.1	<0.1	<0.1
Cymbella	1.7	0.1	0.6	0.1
Diatoma	32.7	2.0	90.8	14.4
D. elongatum	0.2	<0.1		
Fragilaria sp	10.6	0.7	5.9	1.0
F. crotonensis	7.4	0.5	3.7	0.6
Gomphonema	<0.1	<0.1		
Gyrosygma sp	0.1	<0.1		
Melosira granulata	557.7	34.7	215.4	34.1
Rhizosolenia sp			1.4	0.2
Rhoicosphenia curvata	0.6	<0.1	10.1	1.6
Stephanodiscus binderanus	743.3	46.3	0.4	0.1
Stephanodiscus sp			20.5	3.3
Synedra	2.2	0.1	1.3	0.2
Tabellaria fenestrata	53.7	3.3	55.2	8.8
Tabellaria sp			1.4	0.2
Pennalis (unidentified)	42.9	2.7	20.1	3.2
TOTAL	1606.7		631.0	

May 27

S. binderanus and *M. granulata* were the two main taxa found at all locations (Table 3.3-2). Together they contributed to at least 55% of the phytoplankton biomass at the various sampling locations. *S. binderanus* was the main species present at most of the spars. Its relative abundance ranged from 10 to 77%. *M. granulata* was found to be the main taxon present at several locations along the 2.0 and 2.5 km locations on transect E (16 and 13% respectively).

The density of *S. binderanus* ranged between 28 and 1947 mg m^{-3} and was heterogeneously distributed in the study area (Figure 3.3-1A). *M. granulata* occurred in densities from 38 to 1289 mg m^{-3} and was generally found in higher densities in the eastern portion of the study area (Figure 3.3-1B). *Cryptomonas* was found in densities from 7 to 211 mg m^{-3}. Over most of the study area its density was below 125 mg m^{-3} (Figure 3.3-2A). Total phytoplankton biomass at the various sampling locations ranged between 263 and 3182 mg m^{-3}. The higher densities were generally found between transect F around Frenchman Bay and transect J, 0.5 km east of Pickering 'B' (Figure 3.3-2B).

The temperature in the study area on this day ranged between 7.5 and 9.0 C with higher temperatures found between transect H around the generating stations and transect N close to Duffin Creek (Figure 3.3-3).

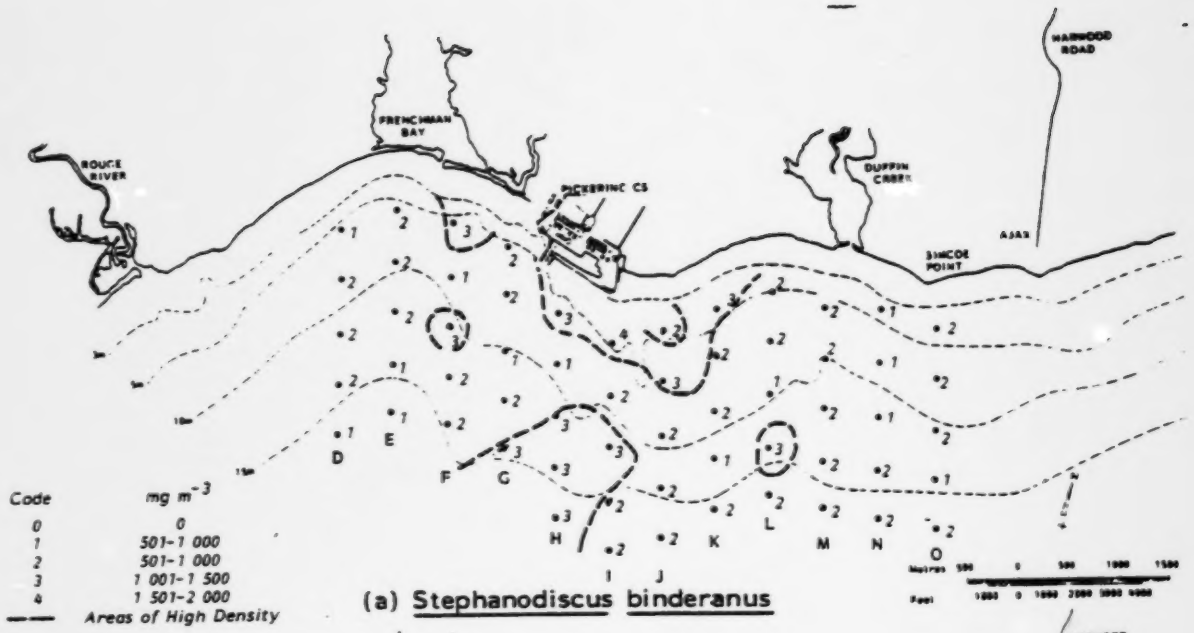
M. granulata was the main phytoplankter found at most locations. Its relative abundance ranged from 5 to 59% of the total phytoplankton biomass (Table 3.3-3). The relative abundance of *Cryptomonas* ranged between 8 and 42% and that of *Diatoma* ranged from 8 to 25%. No trends were obvious in the relative abundances of the three species at the various sampling locations.

The density of *M. granulata* on this day ranged between 19 and 452 mg m^{-3}. Although higher densities were found at several locations along transects N and O at the eastern end of the study area, as well as at spars on transects F, G and H around the stations in approximately the same area higher densities were found on May 27 in the absence of the thermal discharge. The density distribution of this species in general was quite heterogeneous (Figure 3.3-4A). *Cryptomonas* was found in densities from 28 to 289 mg m^{-3} and its distribution was also found to be quite heterogeneous (Figure 3.3-4B). Total phytoplankton biomass ranged between 310 and 1092 mg m^{-3}. The distribution of total phytoplankton biomass reflects that of *M. granulata* (Figure 3.3-5). Surface water temperature on this day ranged from 7.5 C to 15.0 C. Increasingly higher temperatures were found going from the east to the west of the study area with temperatures greater than 10 C generally found to the west of transect H. The distribution of the phytoplankton on this day

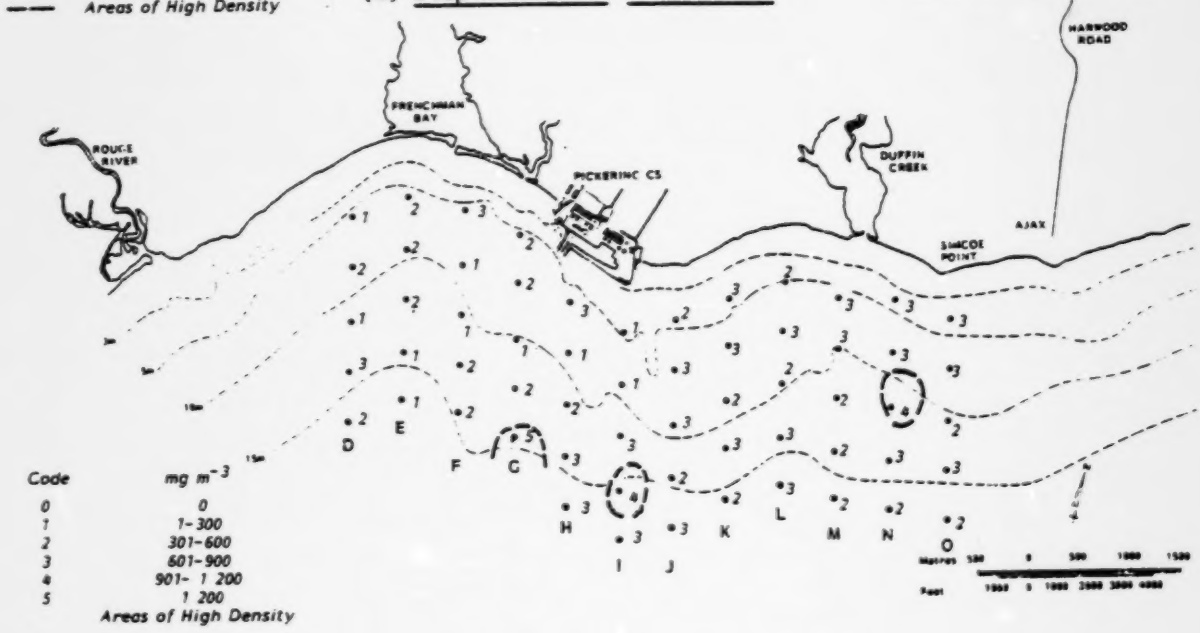
TABLE 3.3-2

Relative Abundances of *Stephanodiscus binderanus* and *Melosira granulata* in Lake Ontario around Pickering GS 'B' on May 27, 1980

Distance from Shore (km)	Taxa	Transect D	E	F	G	H	I	J	K	L	M	N	O
		%											
0.5	*Stephanodiscus binderanus*	70	55	52	51	57	77	54	52	43	40	10	42
	Melosira granulata	15	39	31	40	32	10	33	32	35	43	67	36
1.0	*Stephanodiscus binderanus*	52	49	48	60	75	66	47	44	46	38	19	45
	Melosira granulata	24	32	20	26	12	19	31	37	37	45	52	42
1.5	*Stephanodiscus binderanus*	60	53	47	55	57	54	50	42	40	42	24	54
	Melosira granulata	25	28	32	31	27	32	41	37	37	35	48	26
2.0	*Stephanodiscus binderanus*	44	26	52	48	52	41	55	28	50	53	44	31
	Melosira granulata	37	31	36	34	35	42	27	53	32	26	38	46
2.5	*Stephanodiscus binderanus*	29	25	42	43	45	36	34	50	33	50	48	36
	Melosira granulata	31	40	38	40	31	43	48	32	45	28	27	36



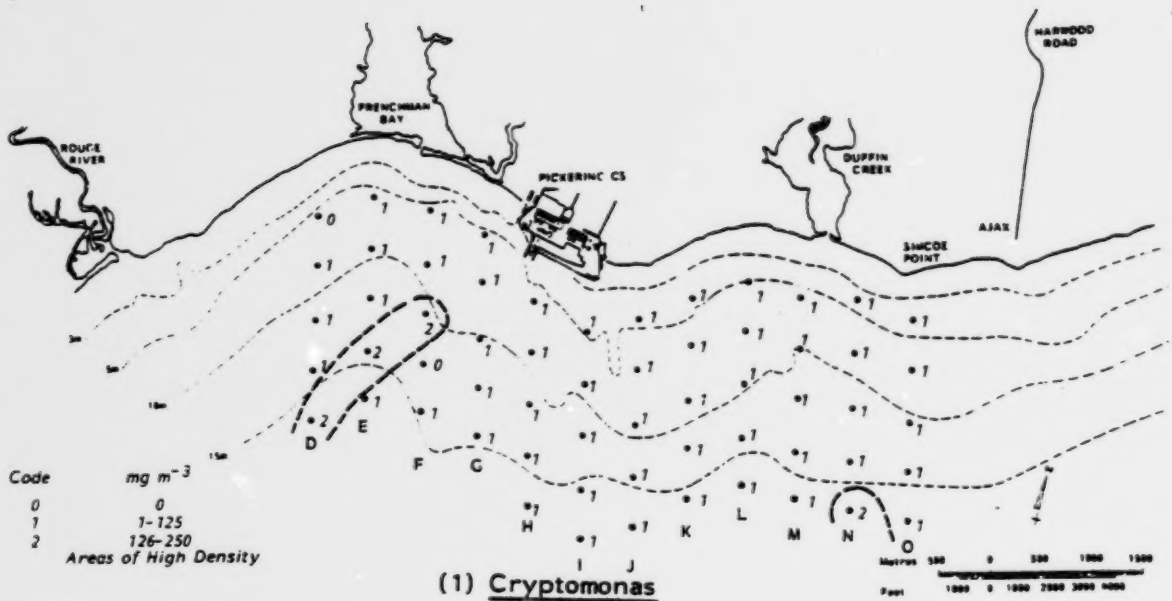
(a) Stephanodiscus binderanus



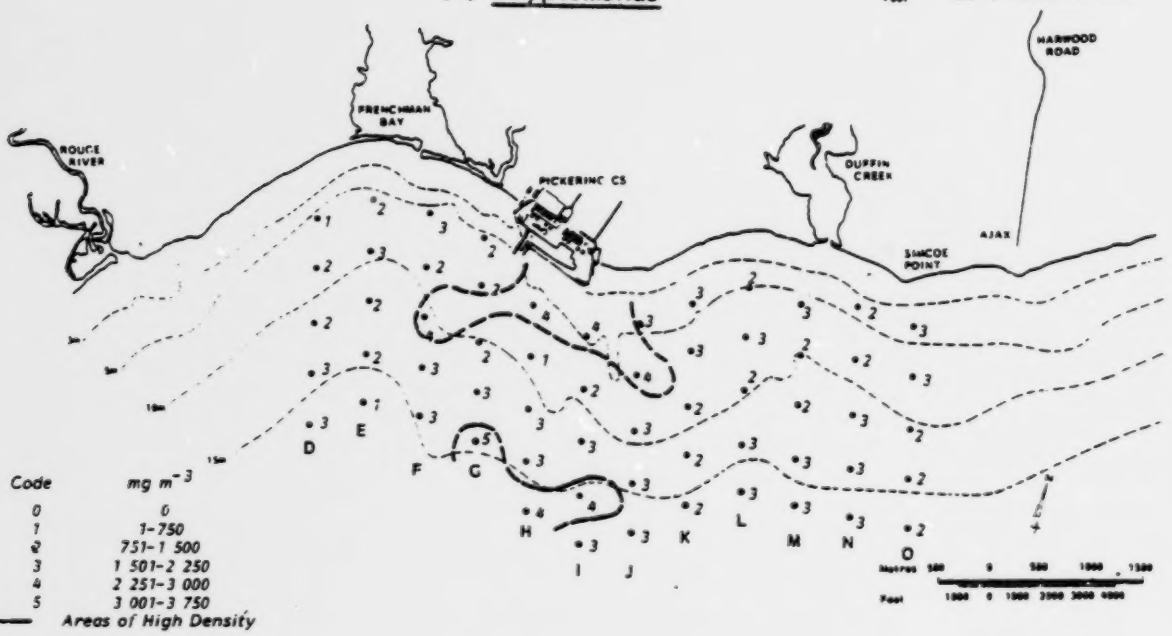
(b) Melosira granulata

FIGURE 3.3-1

DENSITY (mg m^{-3}) DISTRIBUTION OF (a) STEPHANODISCUS BINDERANUS AND (b) MELOSIRA GRANULATA IN LAKE ONTARIO AROUND PICKERING GS 'B' ON MAY 27, 1980



(1) Cryptomonas



(2) Total Phytoplankton Biomass

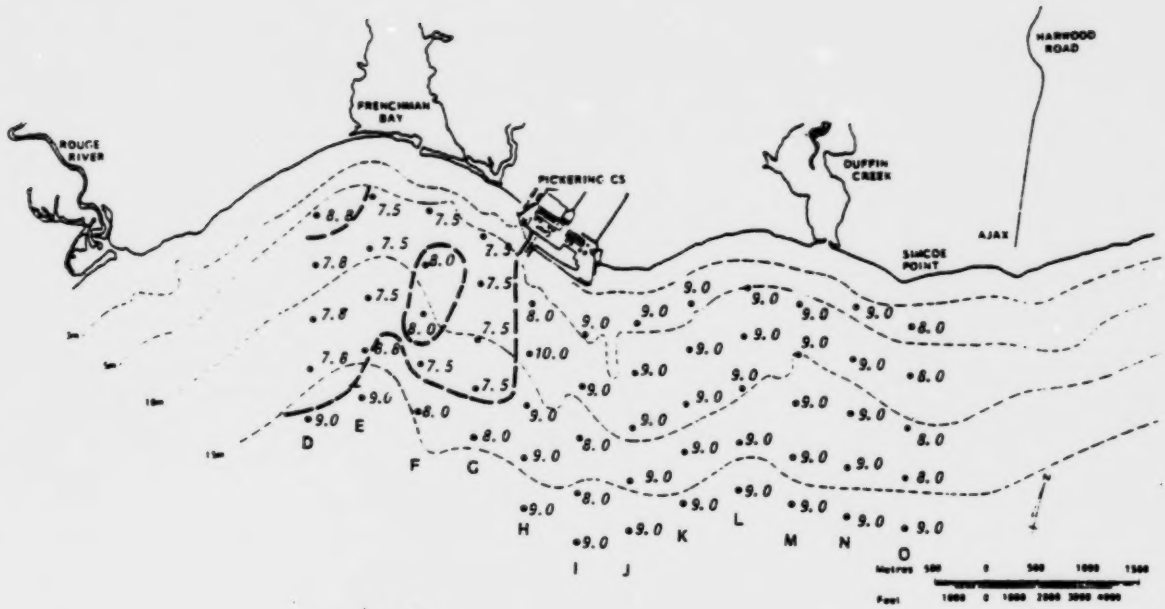
FIGURE 3.3-2
DENSITY (mg m^{-3}) DISTRIBUTION OF (1) CRYPTOMONAS AND (2) TOTAL PHYTOPLANKTON BIOMASS IN LAKE ONTARIO AROUND PICKERING GS 'B' ON MAY 27, 1980

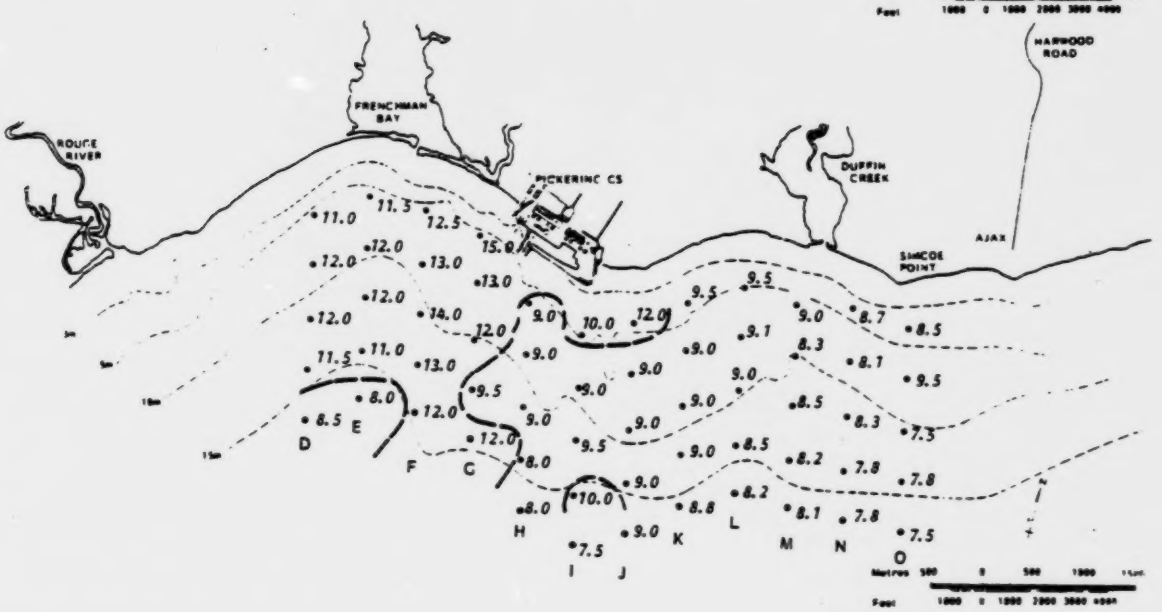
TABLE 3.3-3

Relative Abundances of *Melosira granulata* and *Cryptomonas* sp
in Lake Ontario around Pickering GS 'B'
on June 12 - 1980

Distance from Shore (km)	Taxa	Transect D	E	F	G	H	I	J	K	L	M	N	O
		%											
0.5	*Melosira granulata*	35	39	21	22	28	30	41	32	26	45	10	59
	Cryptomonas	17	23	28	29	27	27	8	18	14	27	42	21
	Diatoma	15	15	15	22	12	13	21	16	21	9	12	11
1.0	*Melosira granulata*	23	26	26	47	33	41	22	24	5	38	45	48
	Cryptomonas	19	16	27	25	25	11	17	35	37	26	18	13
	Diatoma	21	19	14	13	11	23	23	20	25	11	19	12
1.5	*Melosira granulata*	44	40	24	12	33	38	34	28	48	28	40	40
	Cryptomonas	24	12	39	14	21	11	31	36	23	35	14	25
	Diatoma	11	18	18	12	13	13	14	13	12	17	15	10
2.0	*Melosira granulata*	26	31	51	49	48	35	13	21	55	23	37	34
	Cryptomonas	29	13	16	13	29	26	22	38	28	13	33	15
	Diatoma	17	16	8	20	9	13	18	11	10	20	11	17
2.5	*Melosira granulata*	31	26	34	58	41	43	35	21	35	24	20	53
	Cryptomonas	9	12	16	5	20	14	10	48	36	34	15	25
	Diatoma	33	12	12	11	11	15	13	13	14	17	14	10

(a) May 27, 1980

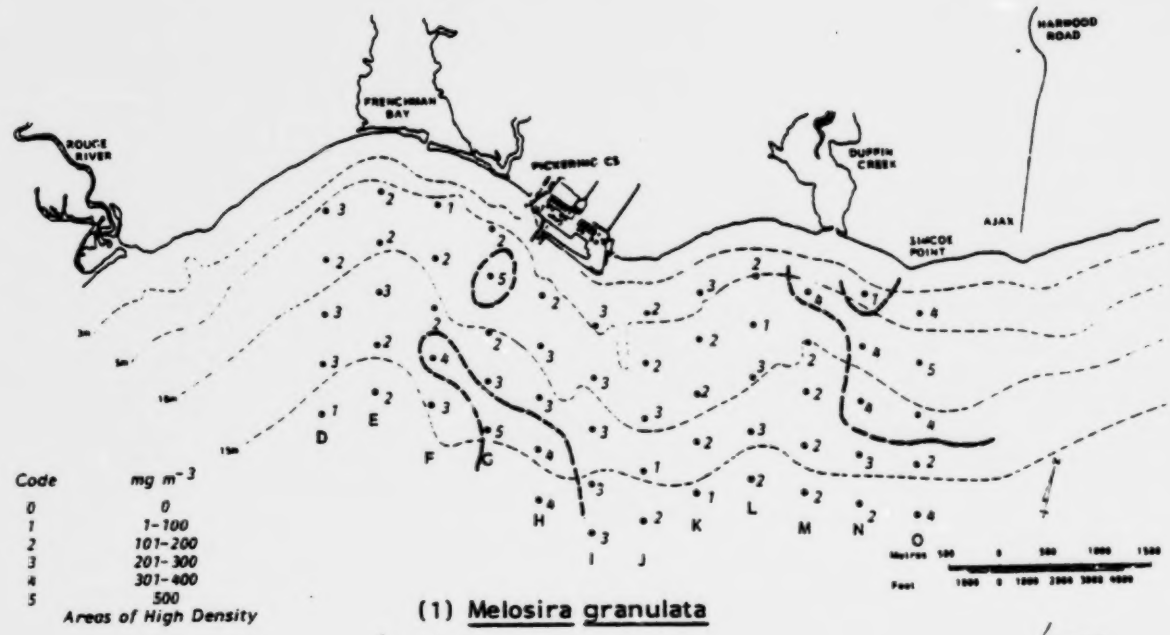




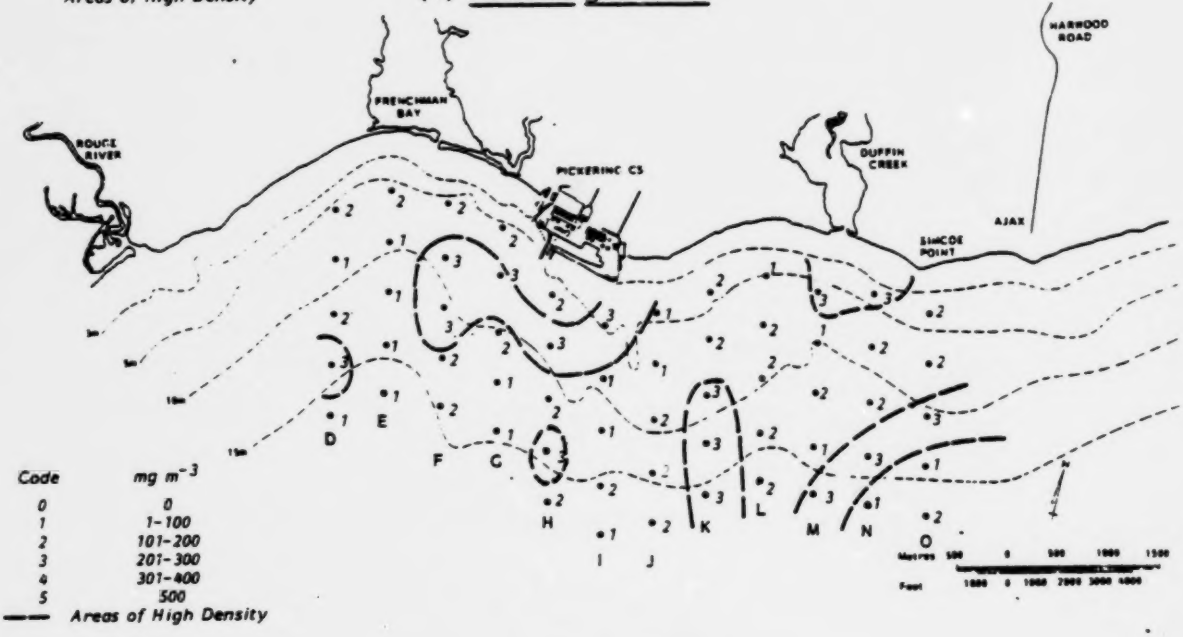
(b) June 12, 1980

FIGURE 3.3-3

TEMPERATURE (°C) DATA FOR PLANKTON SAMPLING LOCATION (a) MAY 27 AND (b) JUNE 12, 1980



(1) Melosira granulata



(2) Cryptomonas

FIGURE 3.3-4

DENSITY DISTRIBUTION OF (1) MELOSIRA GRANULATA AND (2) CRYPTOMONAS IN LAKE ONTARIO AROUND PICKERING GS 'B' ON JUNE 12, 1980

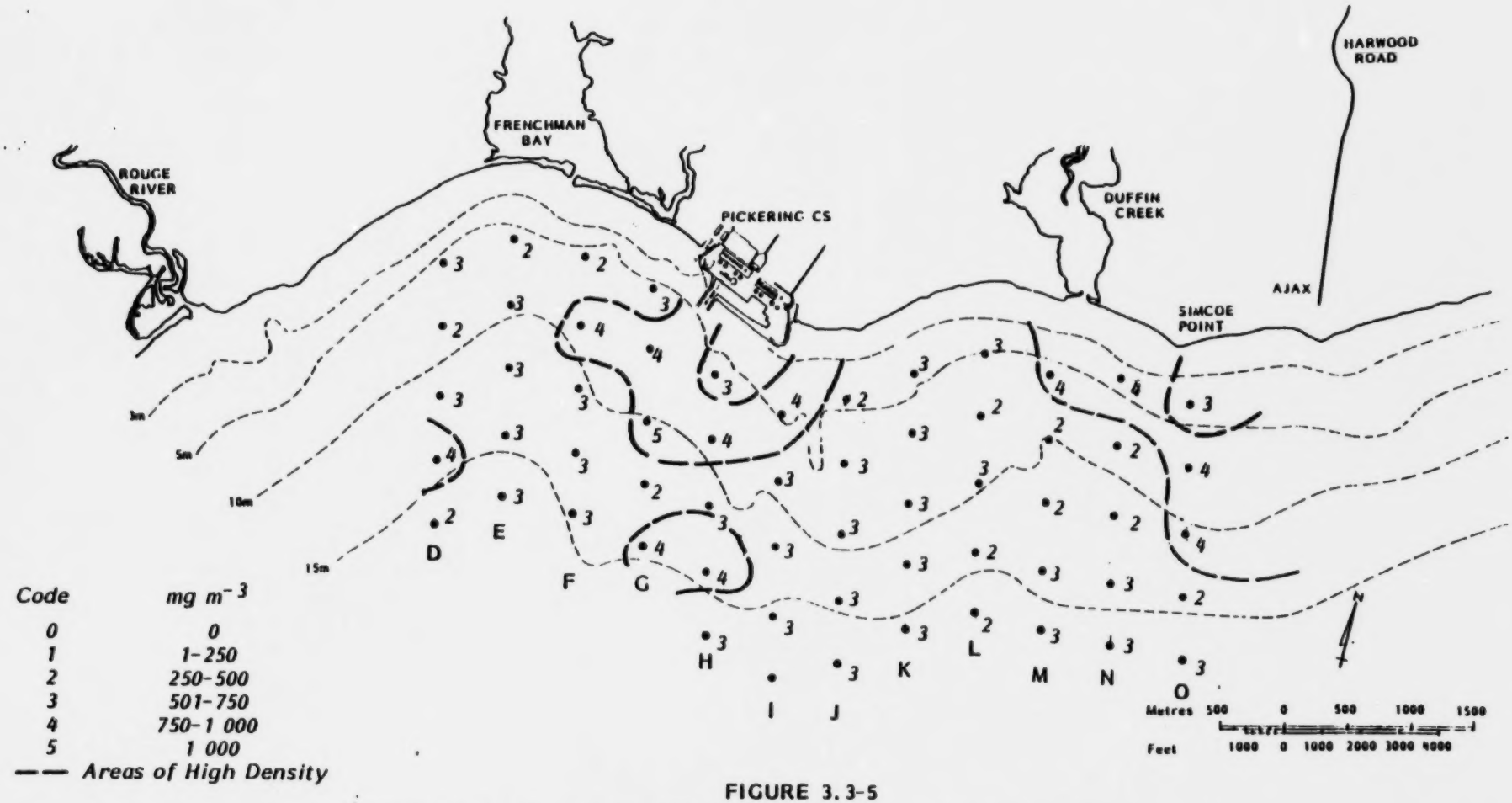


FIGURE 3.3-5

DENSITY (mg m-3) DISTRIBUTION OF TOTAL PHYTOPLANKTON BIOMASS IN LAKE ONTARIO AROUND PICKERING GS 'B' ON JUNE 12, 1980

82-460 154211 RD

does not appear to be related to temperature (Figure 3.3-3A) and no effects of the Pickering 'A' discharge were obvious in the distribution of the phytoplankton.

The mean daily currents at the 8 m depth at a location 1.7 km east of the intake and 1.3 km offshore, were 4.3 and 8.4 cm/sec on May 27 and June 12, respectively. Surface currents are generally faster than those at deeper depths (personal communication, R. Farooqui Hydraulic Studies and Development Department). Since the phytoplankton are entirely dependent on water movement for transportation, with the strong currents in the study area, they probably do not remain in the discharge area for extended periods and effects on population parameters would probably not be detectable in their density distribution.

3.4 Zooplankton

Zooplankton samples were collected at the same times and locations as the phytoplankton samples. Complete zooplankton data for May 27 and June 12 are presented in Appendix IV. The mean densities (no x 10^2 m^{-3}) and relative abundances of the zooplankton present on the two sampling dates are presented in Tables 3.4-1 and 3.4-2.

Numerically the Rotifera was the largest group of zooplankton present on both May 27 and June 12. The total number of rotifers found on these two dates were 925 x 10^2 and 808 x 10^2 m^{-3} respectively. The Cladocera was the smallest group present and made up less than 1% of the total crustacean zooplankton numbers on both days. The total number of crustacean zooplankton present on May 27 was 86 x 10^2 m^{-3} and on June 12 it was 7.9 x 10^2 m^{-3}. *Synchaeta* was the dominant rotifer present in the surface water on May 27 representing 81% of the total rotifer numbers. Its mean density in the study area was 752 x 10^2 m^{-3}. *Notholca laurentiae* and *N. accuminata* were also prominent on this day. The mean density of *N. laurentiae* was estimated to be 1 x 10^2 m^{-3} and its relative abundance was 4%. The mean density of *N. accuminata* was 16 x 10^2 m^{-3} which represented 2% of the total numbers.

Synchaeta was also the main rotifer present on June 12. Its density on this day was 706 x 10^2 m^{-3} and its relative abundance was 54%. *Polyarthra* was the second most abundant rotifer with a density of 50 x 10^2 m^{-3} and represented 23% of the total numbers. Other prominent rotifers present on this day were *N. accuminata* and *Ascomorpha*. The density of *N. accuminata* was 15 x 10^2 m^{-3} (7%) and that of *Ascomorpha* was 13 x 10^2 m^{-3} (6%).

The copepod nauplii made up the largest portions of the crustacean zooplankton numbers on both May 27 (80%) and June 12 (63%). The cyclopoid copepod nauplii were more abundant than the calanoid copepod nauplii on both dates. On May 27 the density of the cyclopoid nauplii was 39 x 10^2 m^{-3} (46%) and that of the calanoid nauplii was 29 x 10^2 m^{-3} (34%). The only adult cyclopoid copepod present was *Diacyclops bicuspidatus thomasi* and the only adult calanoid copepods found were *Diaptomus oregonensis*.

TABLE 3.4-1

Mean Densities (No x $10^2 m^{-3}$) and Relative Abundance (%) of Rotifers Collected in Lake Ontario Around Pickering GS 'B' on May 27 and June 12, 1980

Taxa	May 27		June 12	
	Mean No x $10^2 m^{-3}$	%	Mean No x $10^2 m^{-3}$	%
Brachionus angularis	23.8	2.6	2.5	1.1
Brachionus calyciflorus	1.3	0.1	0.4	0.2
Brachionus urceolaris	0.9	0.1	0.1	<0.1
Brachionus spp			<0.1	<0.1
Kellicottia longispina	1.9	0.2	0.9	0.4
Keratella cochlearis	10.1	1.1	4.1	1.9
Keratella quadrata	4.2	0.5	1.3	0.6
Keratella heimalis	0.1	<0.1	0.1	<0.1
Keratella earlinae	0.8	0.1	4.1	1.9
Lecane luna	0.1	<0.1		
Notholca squamula	17.7	1.9	0.4	0.2
Notholca labis	0.3	<0.1	0.1	<0.1
Notholca foliacea	16.4	1.8	2.9	1.3
Notholca laurentiae	40.5	4.4	2.2	1.0
Notholca acuminata	35.0	3.8	14.6	6.6
Ascomorpha			12.8	5.8
Trichocerca cylindrica	0.1	<0.1		
Gastropus stylifer			0.1	<0.1
Gastropus spp	0.2	<0.1		
Asplanchna spp	10.9	1.2	4.6	2.1
Ploesoma spp	<0.1	<0.1	0.9	0.4
Polyarthra spp	7.9	0.9	49.7	22.6
Synchaeta spp	751.7	81.3	706.4	53.7
Filinia terminalis	0.6	0.1	0.1	<0.1
Filinia longiseta	0.3	<0.1		
Titestudinella patina	0.1	<0.1		
TOTAL	924.9		808.3	

TABLE 3.4-2

Mean Densities and Relative Abundance (%) of Crustacean Zooplankton in Lake Ontario around Pickering GS 'B' on May 27 and June 12, 1980.

	May 27		June 12	
	$NoX10^2m^{-3}$	%	$NoX10^2m^{-3}$	%
Taxa				
Bosmina longirostris	0.1	0.2	<0.1	0.5
Epischura lacustris (CVI)			<0.1	0.2
Diaptomus oregonensis (CVI)	2.5	3.0	1.2	15.0
Diaptomus minutus (CVI)			<0.1	0.4
Diaptomus ashlandi (CVI)			1.0	12.7
Calanoid copepodites (CI-V)	4.4	5.1	0.9	1.2
Calanoid nauplii	29.3	34.3	0.8	10.3
Diacyclops bicuspidatus thomasi (CVI)	2.3	2.7	0.2	2.2
Cyclopoid copepodites (CI-V)	7.9	9.2	0.3	4.4
Cyclopoid nauplii	39.1	45.6	4.2	53.1
TOTAL	85.6		7.9	

The cyclopoid copepodites (including adults) occurred in a density of 10 x 10^2 m^{-3} which represented about 10% of the crustacean zooplankton numbers and the calanoid copepodites (including adults) were found in a density of 7 x 10^2 m^{-3} which was 8% of the total numbers. *Bosmina longirostris* was the only cladoceran present. Its density was only 0.1 x 10^2 m^{-3} and it accounted for less than 1% of the total numbers. The total crustacean zooplankton density on this day was 86 x 10^2 m^{-3}.

On June 12 the density of the crustacean zooplankton (8 x 10^2 m^{-3}) was substantially lower than it had been on May 27. The cyclopoid nauplii contributed to 53% of the total number of crustacean zooplankton with a density of 4.2 x 10^2 m^{-3}. *D. oregonensis* adults made up the second largest portion with a density of 1.2 x 10^2 m^{-3} and *D. ashlandi* adults followed with a density of 1.0 x 10^2 m^{-3}. The relative abundances of the *D. oregonensis* and *D. ashlandi* adults were 15 and 13% respectively. The only adult cyclopoid copepods present were *Diacyclops bicuspidatus thomasi*. *B. longirostris* was again the only cladoceran present. Its density was less than 0.1 x 10^2 m^{-3} and it contributed to less than 1% of the total numbers.

Nauwerck (1978) studied the composition and abundance of rotifers in Lake Ontario and found *Synchaeta, Notholca and Kellicottia* to be dominant in the winter. He found *Keratella* to be the most important species present in the summer with *Synchaeta, Ploesoma* and *Asplanchna* also being prominent in the summer. In the fall *Polyarthra* was the most important species present while *Keratella, Trichocerca* and *Collotheca* were also major contributors to the fall composition of the rotifers of Lake Ontario (Nauwerck 1978). Nauwerck (1978) placed *Synchaeta* and *Notholca*, the main genera present in our study area on May 27, in a group of rotifers with affinities towards cold, oligotrophic water. *Polyarthra*, which along with *Synchaeta* was one of the main genera present on June 12, was described as a genus with no clear expression of preference for temperature and trophic conditions (Nauwerck, 1978).

Synchaeta present in the samples collected in 1980 were not speciated; however, a portion of the *Synchaeta* present in the 1979 samples (Pickering GS 'B' Preoperational Biological Study - year I) were speciated and *S. pectinata* was the main form identified. The only other form of *Synchaeta* identified was *S. oblonga*. According to Nauwerck (1978) *S. pectinata* occurs in Lake Ontario in moderate numbers from summer through fall with a preference for warmer and inshore waters. In previous years *N. laurentiae* has been included with *N. squamula*. In Lake Ontario the forms are morphologically similar and are distinguished solely on the basis of size (Nauwerck 1978). *N. laurentiae* described by Nauwerck as *N. striata* (Stemberger 1976) is the most common *Notholca* form in Lake Ontario (Nauwerck, 1978). *N. acuminata* is described by Nauwerck (1978) as a winter species which occurs in Lake Ontario from December until May-June, and longer in deeper waters. *Polyarthra* present in 1980 samples were also not speciated. However, in 1979

samples, *P. dolichoptera* was identified as the main form present in spring and summer while *P. vulgaris* was the main form present in the fall. Nauwerck (1978) found *P. dolichoptera* to be an important species in Lake Ontario with peak abundance in late spring and a preference for inshore regions. *P. vulgaris* was described by Nauwerck (1978) as one of the quantitatively important rotifers of Lake Ontario which can be found year round and practically everywhere in the lake.

Patalas (1969) found *Diacyclops bicuspidatus thomasi (= Cyclops bicuspidatus thomasi)* to be the most abundant copepod in Lake Ontario. In June he found the species to be evenly distributed throughout nearshore regions of the lake with the exception of the areas off Toronto where lower densities were found. Patalas (1969) found low densities of *D. minutus*, *D. oregonensis*, and *D. sicilis*. *D. ashlandi* present in our June 12 samples has only been recorded for Lake Ontario by McNaught and Buzzard (1974). Patalas (1969) found *B. longirostris* to be the most abundant crustacean in the summer plankton of Lake Ontario. The crustacean zooplankton species list obtained for the two sampling dates, especially of the cladocerans, was quite short compared to that obtained in 1979 or those presented in the literature for Lake Ontario (Patalas 1969; McNaught and Buzzard 1973; Watson and Carpenter 1974). Surface water temperatures on May 27 and June 12 were quite low compared to those observed at the time the May, 1979 samples were collected and may account to some degree for the differences observed. The ambient temperatures on May 27 and June 12 in 1980 was about 9 C while on May 29, 1979 it was about 12 C. The cooler temperatures that prevailed through June of 1979 may be indicative of a disturbance such as an upwelling resulting in the atypical species composition.

May 27

On this day Synchaeta was the dominant rotifer taxon present at all but five of the 60 sampling locations (Table 3.4-3). Where it was dominant, it made up between 41 and 94% of the rotifer numbers. *N. laurentiae* and *N. accuminata* were the two main species present at the 0.5 km offshore spar on transect E, the 1.0 km spar on transect D, the 1.5 km spar on transects E and I and the 2.0 km spar on transect M. At these locations the *Notholca* species represented between 43 and 69% of the rotifers. The copepod nauplii made up the largest portions of the crustacean zooplankton numbers at all of the sampling locations contributing to between 34 and 100% of the total numbers (Table 3.4-4). Generally the calanoid copepod nauplii were more prominent than the cyclopoid nauplii on the west side of the study area along transects D and E. The reverse was true in the remainder of the study area.

The density of Synchaeta in the study area varied considerably and ranged between 3×10^2 and 128×10^2 m^{-3}. It occurred in higher abundance between transects F and I and was found in highest abundance along transect G around the Pickering 'A'

TABLE 3.4-3

Relative Abundance of *Synchaeta* spp, *Notholca laurentiae* and *Notholca acuminata* in Lake Ontario around Pickering GS 'B' on May 27, 1980

Distance from Shore (km)	Taxa	Transect D	E	F	G	H	I	J	K	L	M	N	O
		%											
0.5	*Synchaeta*	86	4	80	78	76	80	85	74	88	91	79	80
	Notholca laurentiae	1	52	7	8	4	3	4	8	4	1	6	3
	N. acuminata	5	17	5	8	5	1	3	4	2	3	6	6
1.0	*Synchaeta*	4	51	70	81	82	81	75	76	58	77	48	81
	Notholca laurentiae	45	23	6	4	6	6	5	7	8	4	16	2
	N. acuminata	19	5	5	5	3	3	2	3	11	9	23	4
1.5	*Synchaeta*	87	5	80	86	81	81	88	89	86	89	83	73
	Notholca laurentiae	5	40	6	4	6	19	2	2	2	1	2	3
	N. acuminata	3	17	4	4	3	24	1	2	3	1	1	2
2.0	*Synchaeta*	84	94	85	83	78	89	92	90	85	6	87	76
	Notholca laurentiae	5	1	3	4	4	1	1	3	1	22	1	2
	N. acuminata	2	1	4	5	5	2	1	1	4	31	2	3
2.5	*Synchaeta*	90	91	89	88	84	19	89	91	81	93	88	93
	Notholca laurentiae	3	1	3	1	3	2	1	1	5	1	0	<1
	N. acuminata	1	2	3	4	1	3	<1	2	6	<1	1	<1

TABLE 3.4-4

Relative Abundance of Cyclopoid and Calanoid copepod nauplii in Lake Ontario around Pickering GS 'B' on May 27, 1980

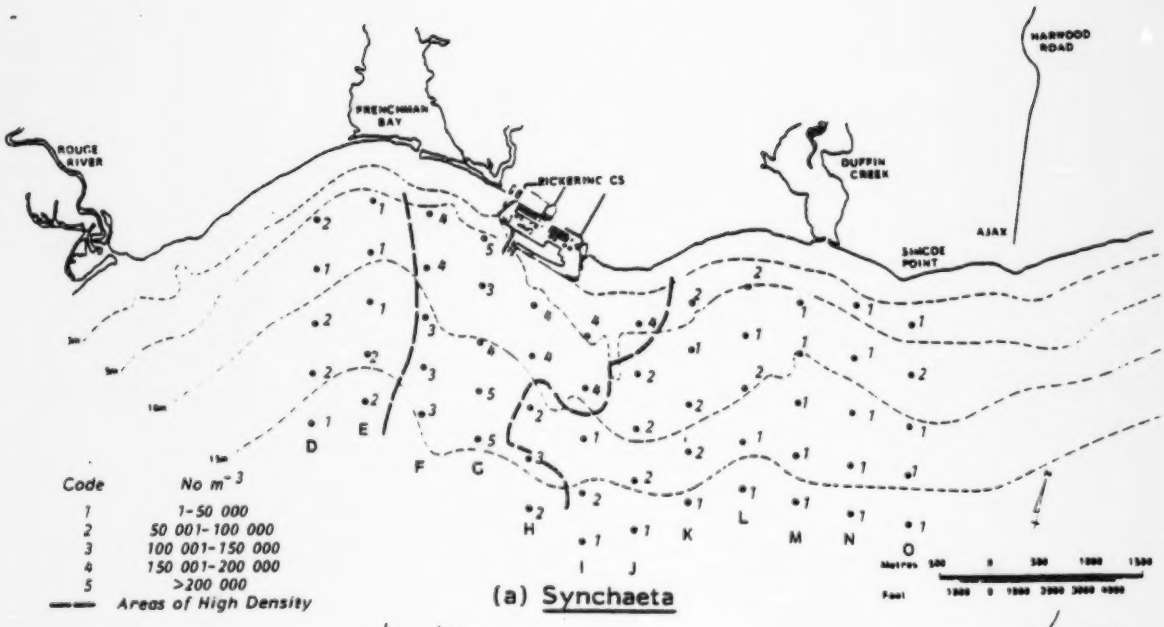
Distance from Shore (km)	Taxa	Transect											
		D	E	F	G	H	I	J	K	L	M	N	O
		%											
0.5	Cyclopoid copepod nauplii	35	29	28	62	33	46	50	50	49	43	21	56
	Calanoid copepod nauplii	54	66	62	28	51	29	21	26	31	50	64	32
1.0	Cyclopoid copepod nauplii	33	33	38	57	56	60	50	48	17	41	51	60
	Calanoid copepod nauplii	61	59	50	21	23	17	23	20	17	28	34	23
1.5	Cyclopoid copepod nauplii	38	42	36	50	52	32	56	57	32	44	86	64
	Calanoid copepod nauplii	50	49	52	24	15	46	24	26	30	22	14	23
2.0	Cyclopoid copepod nauplii	39	25	54	55	39	37	56	50	44	46	63	65
	Calanoid copepod nauplii	58	67	33	26	18	49	16	29	22	23	38	29
2.5	Cyclopoid copepod nauplii	25	37	48	51	44	53	59	60	17	35	57	53
	Calanoid copepod nauplii	63	55	37	27	14	20	15	14	35	19	43	33

discharge (Figure 3.4-1A). The density of *N. laurentiae* also varied substantially and ranged from 1 x 10^2 to 176 x 10^2 m^{-3}. Higher densities were found at the inshore spars along transects E and I and in the area between these two transects (Figure 3.4-1B). Highest abundance was found at the spar closest to the Pickering 'A' discharge (0.5 km spar on transect G). *N. acuminata* occurred in densities between 1 x 10^2 and 206 x 10^2 m^{-3}. Its density distribution was approximately similar to that of *N. laurentiae* (Figure 3.4-2A). It was also found in highest concentration at the location closest to the Pickering 'A' discharge. The cyclopoid nauplii were found in densities ranging from 3 x 10^2 to 128 x 10^2 m^{-3}. They occurred in higher abundance from the nearshore area along transect E southeast to transect K (Figure 3.4-2B). The calanoid nauplii were found in concentrations of 3 x 10^2 to 136 x 10^2 m^{-3} with higher densities prevalent in the western portion of the study area especially along transects E and F.

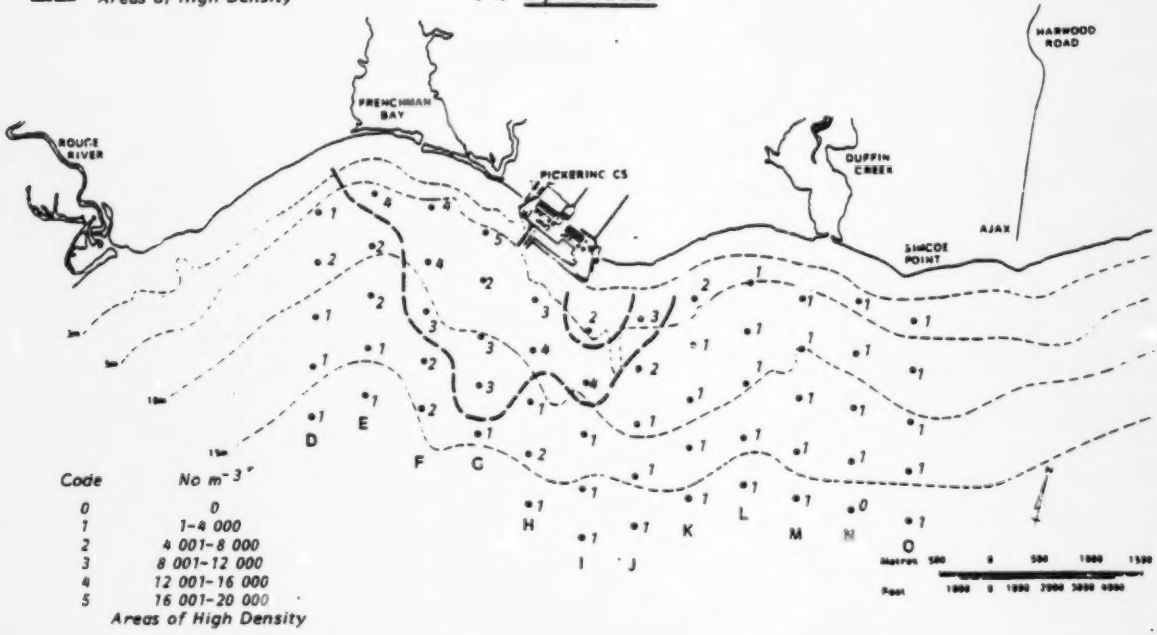
On May 27 the surface water temperatures were between 7.5 and 9.0 C (Figure 3.4-3A) except at the 1.0 km spar on transect H where the temperature was 10°C. The lower temperatures were generally found on the four western transects. The main zooplankton present on this day were generally more abundant to the south and southwest of the generating stations, the area encompased by the thermal plume on two out of the three 1979 sampling dates (Pickering 'B' Preoperational Biological Study - Year I) and on June 12, 1980 when the plant was back in operation (Figure 3.4-3B). Thus on this day under ambient temperature conditions the densities of the zooplankton appeared to be naturally higher in the area frequently included in the thermal plume.

June 12

On this day *Synchaeta* spp (including *Synchaeta stylata)* and *Polyarthra* spp were the two main taxa present at most spars. *Synchaeta* was not found 2.5 km offshore on transect I (Table 3.4-5). At the remaining locations it made up between 14 and 88% of the rotifer numbers. Its relative abundance was generally higher in the eastern portion of the study area. *Polyarthra* spp was present at all locations and represented between 7 and 56% of the total numbers. *N. acuminata* was also prominent at most spars representing between 1 and 38% of the where it occurred. The cyclopoid copepod nauplii made up the largest portion of the crustacean zooplankton found at all but four of the sixty sampling locations. They were the only crustacean zooplankton found in several samples collected on transects D, E, L, M and N (Table 3.4-6). The crustacean zooplankton densities on this day were quite low and consequently numbers collected and counted were very low. *D. oregonensis* and *D. ashlandi* adults were found to be less prominent along transects D and E and at the three offshore spars along transects L, M, and N than in the remainder of the study area.



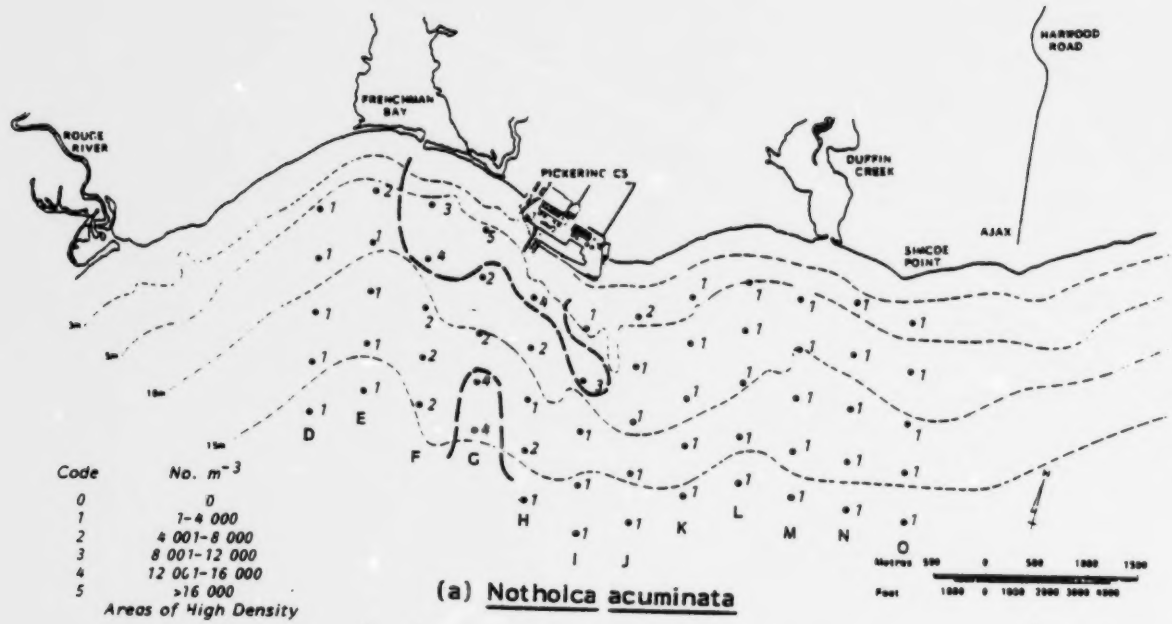
(a) Synchaeta



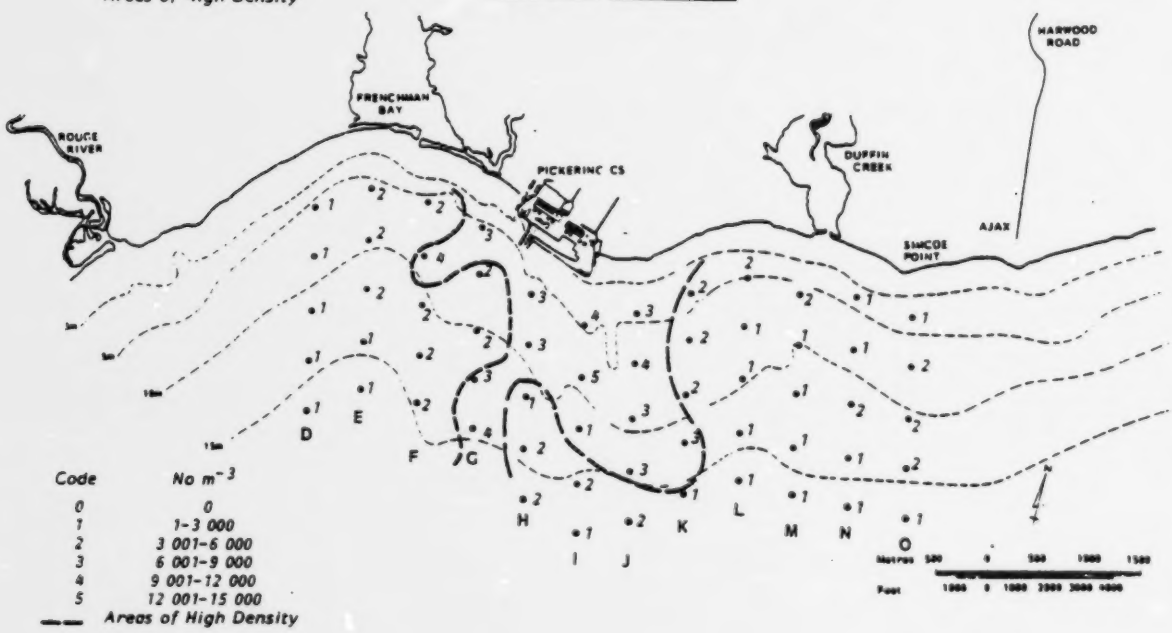
(b) Notholca laurentaie

FIGURE 3.4-1

DENSITY (No m^{-3}) DISTRIBUTION OF (a) SYNCHAETA AND (b) NOTHOLCA LAURENTIAE IN LAKE ONTARIO AROUND PICKERING GS 'B' ON MAY 27, 1980



(a) Notholca acuminata



(b) Cyclopoid copepod nauplii

FIGURE 3.4-2

DENSITY (No m^{-3}) DISTRIBUTION OF (a) NOTHOLCA ACUMINATA AND (b) THE CYCLOPOID COPEPOD NAUPLII IN LAKE ONTARIO AROUND PICKERING GS 'B' ON MAY, 1980

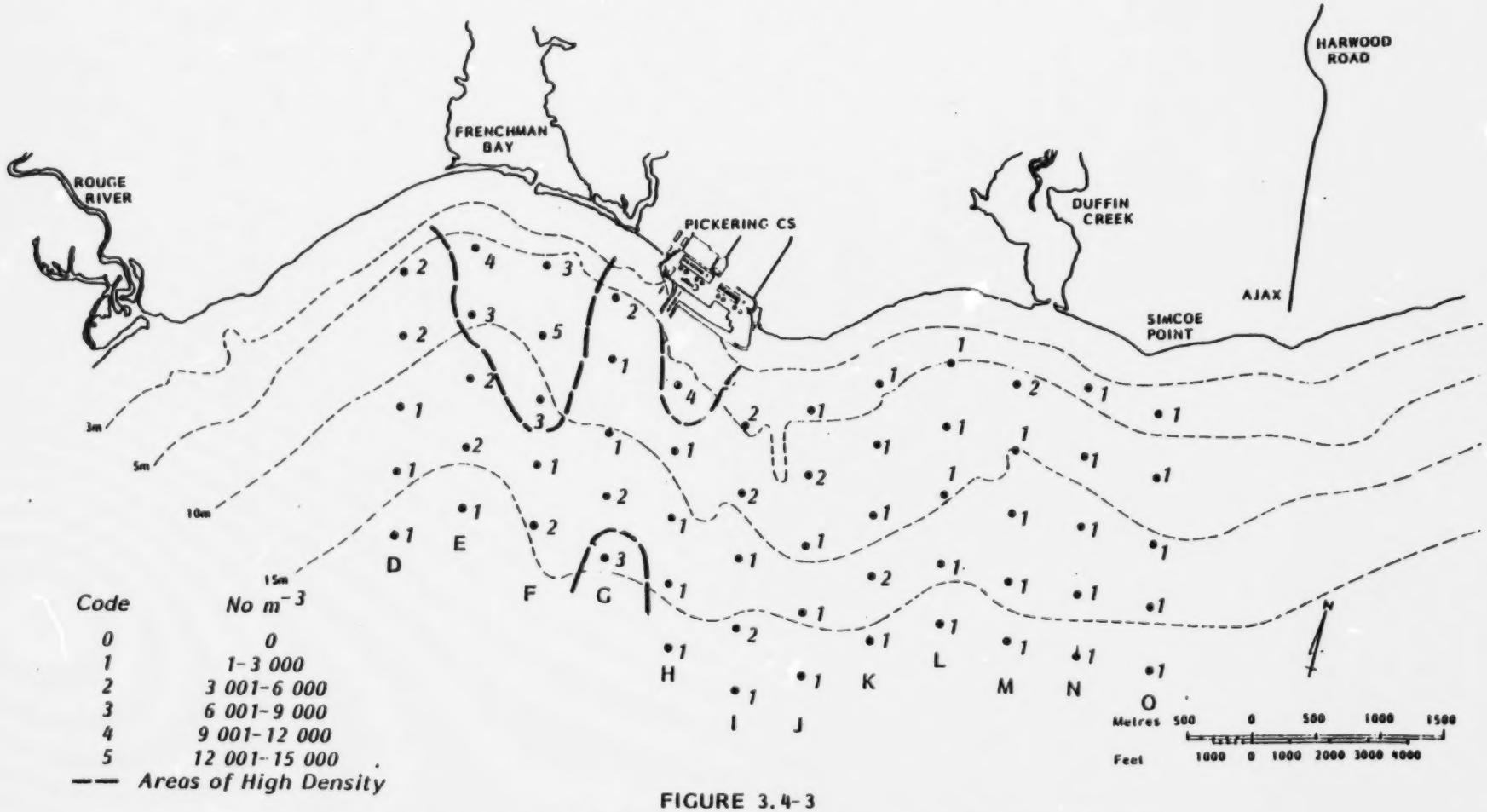


FIGURE 3.4-3

DENSITY (No m^{-3}) DISTRIBUTION OF THE CALANOID COPEPOD NAUPLII IN LAKE ONTARIO AROUND PICKERING GS 'B' ON MAY 27, 1980

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82-460

TABLE 3.4-5

Relative Abundance of *Synchaeta* spp*, *Polyarthra* spp, and *Notholca acuminata* in Lake Ontario around Pickering GS 'B' on June 12, 1980

Distance from Shore (km)	Taxa	Transect D	E	F	G	H	I	J	K	L	M	N	O
		%											
0.5	*Synchaeta*	46	26	28	37	30	35	46	56	47	53	66	48
	Polyarthra	34	33	36	17	26	31	32	28	20	32	20	24
	Notholca acuminata	4	12	9	17	21	8	7	1	0	1	2	7
1.0	*Synchaeta*	24	21	44	46	49	31	44	46	39	63	68	63
	Polyarthra	52	52	39	21	20	29	20	19	26	21	25	20
	Notholca acuminata	5	7	4	10	14	11	22	26	1	2	1	5
1.5	*Synchaeta*	21	24	49	36	31	40	36	66	46	60	57	64
	Polyarthra	38	47	21	26	32	24	24	20	10	26	32	10
	Notholca acuminata	22	10	6	16	24	14	16	2	2	2	5	10
2.0	*Synchaeta*	19	32	38	49	26	46	88	63	63	62	67	72
	Polyarthra	25	24	39	20	16	24	7	17	9	30	15	7
	Notholca acuminata	20	14	10	14	19	10	3	10	6	1	11	5
2.5	*Synchaeta*	27	35	38	45	26	0	33	69	14	63	68	60
	Polyarthra	13	12	26	32	12	56	11	15	30	28	11	15
	Notholca acuminata	23	20	13	4	38	3	33	6	16	2	11	13

* includes *Synchaeta Stylata*

TABLE 3.4-6

Relative Abundance of Cyclopoid copepod nauplii *Diaptomus oregonensis* (CVI) and *Diaptomus ashlandi* (CVI) in Lake Ontario around Pickering GS 'B' on June 12, 1980

Distance from Shore (km)	Taxa	Transect											
		D	E	F	G	H	I	J	K	L	M	N	O
		%											
0.5	Cyclopoid copepod nauplii	42	60	40	56	51	42	63	56	58	58	75	47
	Diaptomus oregonensis	0	15	12	5	12	16	17	27	21	21	25	0
	D. ashlandi	0	0	0	4	11	19	20	0	21	21	0	33
1.0	Cyclopoid copepod nauplii	43	76	62	76	30	38	49	72	47	45	52	41
	Diaptomus oregonensis	0	0	0	7	33	22	24	29	26	18	17	8
	D. ashlandi	0	0	15	6	16	21	0	0	26	15	31	45
1.5	Cyclopoid copepod nauplii	100	80	50	67	46	40	56	41	100	100	100	33
	Diaptomus oregonensis	0	0	13	12	18	12	28	22	0	0	0	36
	D. ashlandi	0	0	13	9	27	44	0	0	0	0	0	30
2.0	Cyclopoid copepod nauplii	73	82	62	49	39	0	79	25	60	100	58	31
	Diaptomus oregonensis	0	18	17	29	24	40	0	11	0	0	0	0
	D. ashlandi	0	0	10	11	27	42	0	14	0	0	0	39
2.5	Cyclopoid copepod nauplii	100	100	37	54	53	33	53	72	69	100	100	46
	Diaptomas oregonensis	0	0	20	40	10	38	0	28	0	0	0	21
	D. ashlandi	0	0	11	0	0	29	0	0	0	0	0	17

On June 12 the density of *Synchaeta* varied considerably and ranged from 6 x 10^2 to 672 x 10^2 m^{-3}. Higher densities were found in the eastern portion of the study area east of transect J with highest density found at the 0.5 km spar on transect N east of Duffin Creek (Figure 3.4-4A). *Polyarthra* was found in concentrations between 4 x 10^2 and 215 x 10^2 m^{-3} and its distribution was approximately similar to that of *Synchaeta* (Figure 3.4-4B). The density of the cyclopoid copepod nauplii ranged between transects E and H. They were found in highest densities along transect G close to the Pickering 'A' discharge (Figure 3.4-5A). The *D. oregonensis* adults were found in concentrations of 1 x 10^2 to 7 x 10^2 m^{-3}. They occurred in higher abundance in the area around the generating stations between transects F and I (Figure 3.4-5B).

The surface water temperatures in the study area ranged between 7.5 and 15.0°C with higher temperatures found west of transect G and nearshore along transects I and J which partly encompasses the area where higher crustacean zooplankton densities were found. However their distribution was quite similar on May 27 in the absence of a thermal discharge when they were also found in higher abundances around the stations.

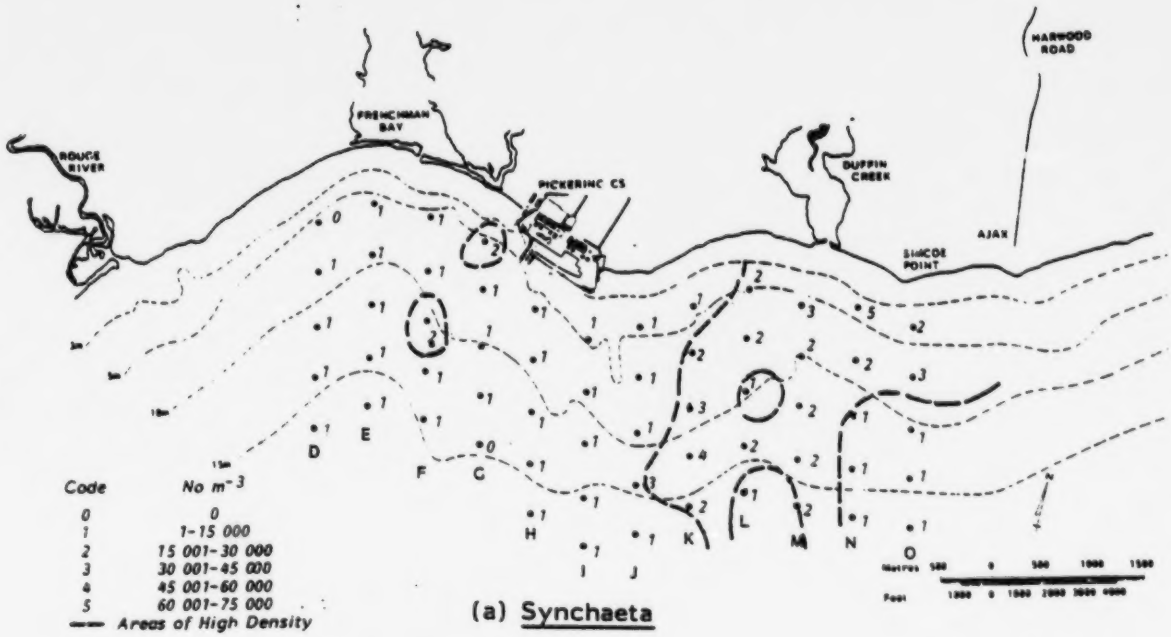
The surface currents in the study area are generally quite high. On May 27 and June 12, 1981, the current at the 8 m depth at a location 1.7 km east of the intake, 1.3 km offshore, the mean daily currents were 4.3 and 8.4 cm/sec. The current in the surface water stratum, where the zooplankton were sampled are generally higher than they are at 8 m (personal communication, R. Farooqui, Hydraulic Studies and Development Department). With the strong currents it is unlikely that the zooplankton remain in the thermal plume for extended periods, but are rapidly transported out of the discharge and effects of the thermal plume would probably not be detectable in their density distribution.

Evans (1980) in explaining the higher zooplankton densities she found in the warmer waters of the Donald C. Cook nuclear power plant thermal plume found that water temperature was not a reliable indicator of alterations in zooplankton populations and suggested that the changes were primarily due to upward vertical displacement of deep-living zooplankton. Data obtained on the vertical distribution of the zooplankton on June 17, 1976 around Pickering GS (12 m depth) indicated higher abundances of *D. bicuspidatus thomasi*, cyclopoid nauplii and *B. longirostris* in the deeper waters during the daytime (OHRD Report No C78-78-K). *Polyarthra* and *Synchaeta* were also more abundant below the 1 m subsurface statum (OHRD Report No C78-78-K.

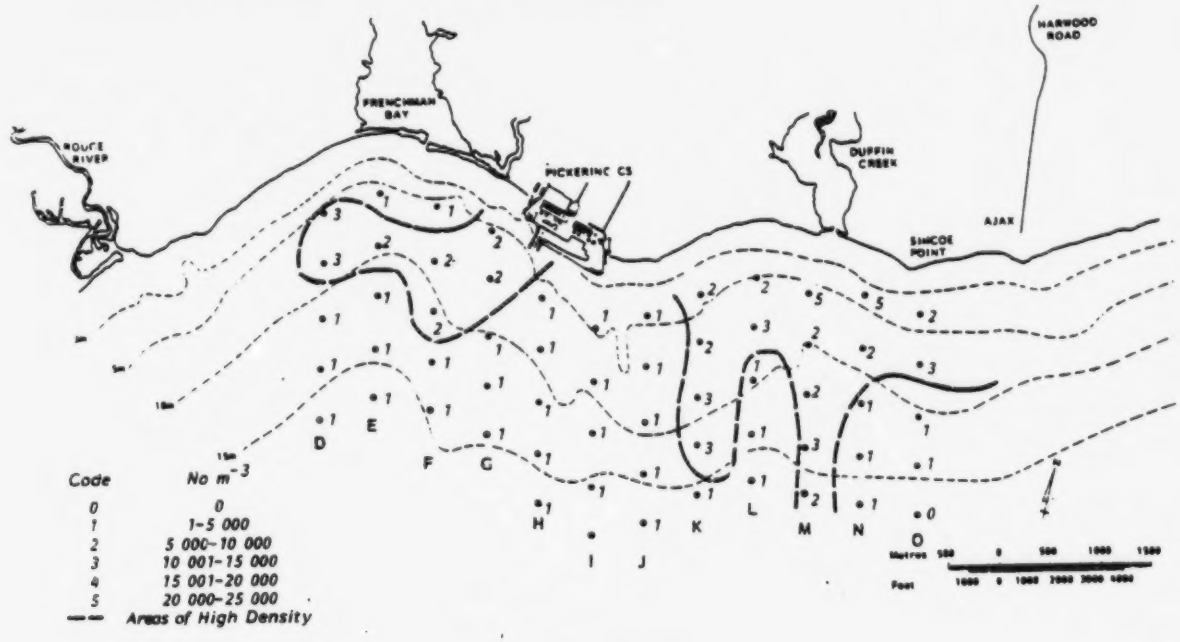
3.5 Fish

Ichthyoplankton

Complete fish egg data collected in larval fish samples from the Pickering 'A' intake forebay and at the intake of the Scott Water Treatment Plant between March 26 and June 25, 1981 are presented in Table 3.5-1.



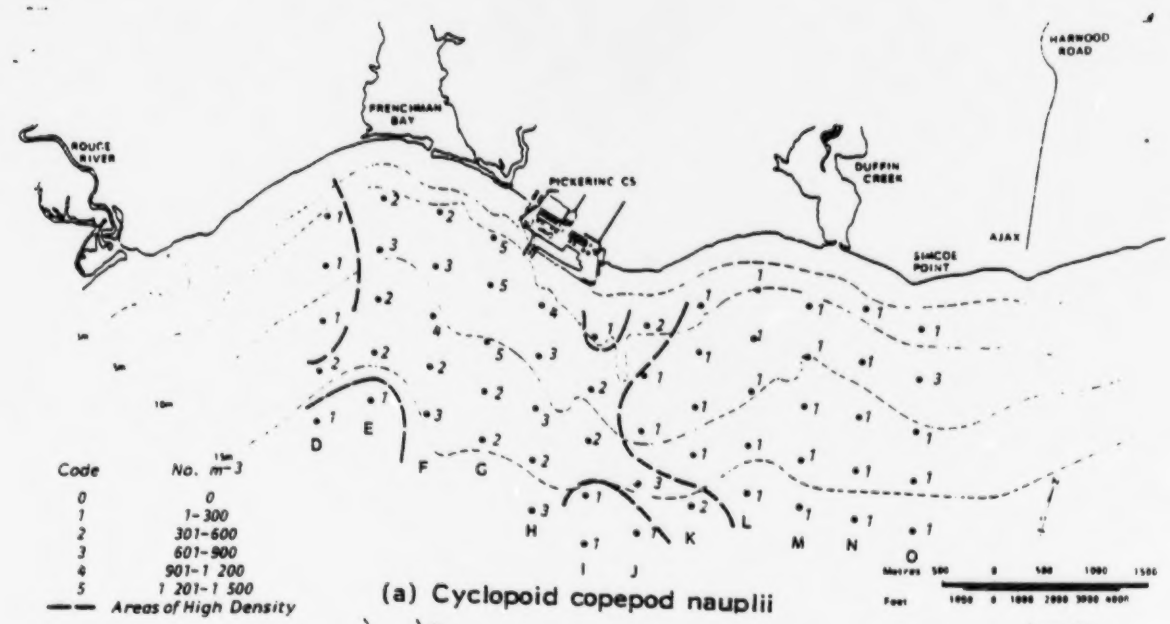
(a) Synchaeta



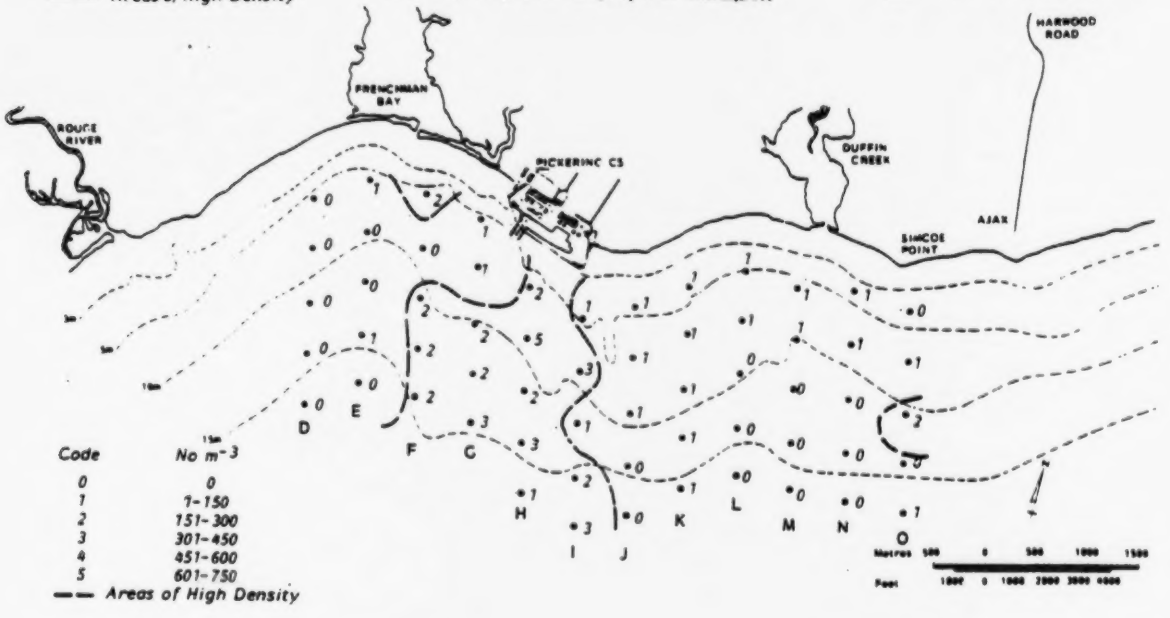
(b) Polyarthra

FIGURE 3.4-4

DENSITY (No m^{-3}) DISTRIBUTION OF (a) SYNCHAETA AND (b) POLYARTHRA IN LKAE ONTARIO AROUND PICKERING GS 'B' ON JUNE 12, 1980



(a) Cyclopoid copepod nauplii



(b) Diaptomus oregonensis adults

FIGURE 3.4-5

DENSITY (No m^{-3}) DISTRIBUTION OF (a) CYCLOPOID COPEPOD NAUPLII AND (b) DIAPTOMUS OREGONENSIS ADULTS IN LAKE ONTARIO AROUND PICKERING GS 'B" ON JUNE 12, 1980

TABLE 3.5-1

NUMBERS AND DENSITIES OF FISH EGGS COLLECTED IN THE PICKERING 'A' INTAKE FOREBAY AND AT THE INTAKE PIPE OF THE SCOTT WATER TREATMENT PLANT - PREOPERATIONAL STUDY, YEAR II, 1980

Pickering 'A' Intake Forebay

Day Tows				
Date	Species	No	Volume of Water Filtered (m^3)	Density per 1000 m^3
April 16, 1980	Rainbow Smelt	220	302.3	727.8
April 23, 1980	Rainbow Smelt	42	333.7	3.0
May 07, 1980	Rainbow Smelt	2 498	288.9	8 646.6
May 14, 1980	Rainbow Smelt	15	70.3	213.4
May 21, 1980	Rainbow Smelt	7	5.3	1 333.3
May 28, 1980	Rainbow Smelt	3	11.6	258.6
June 04, 1980	Rainbow Smelt	3	19.4	154.6
June 25, 1980	Alewife	26	34.3	758.0
Night Tows				
April 16, 1980	Rainbow Smelt	20	274.2	72.9
April 23, 1980	Rainbow Smelt	28	236.2	118.6
April 30, 1980	Rainbow Smelt	4	325.3	12.3
May 07, 1980	Rainbow Smelt	2 165	249.0	8 694.8
May 14, 1980	Rainbow Smelt	5	22.9	218.3
May 22, 1980	Rainbow Smelt	60	18.7	3 210.3
May 28, 1980	Rainbow Smelt	3	14.7	203.8
June 04, 1980	Rainbow Smelt	3	16.1	186.7

Scott Water Treatment Plant

Day Tows				
Date	Species	No	Volume of Water Filtered (m^3)	Density per 1000 m^3
May 14, 1980	Rainbow Smelt	3	3.9	764
May 21, 1980	Rainbow Smelt	30	4.4	6 756.8
May 28, 1980	Rainbow Smelt	5	1.9	2 631.6
June 11, 1980	Rainbow Smelt	2	7.9	254.5
Night Tows				
May 07, 1980	Rainbow Smelt	15	2.0	7 425.7
May 14, 1980	Rainbow Smelt	299	2.9	103 819.4
May 21, 1980	Rainbow Smelt	1	5.2	193.4

In the Pickering 'A' intake forebay, smelt eggs were first collected on April 16, with highest day and night densities (8647 and 8695/1000 m^3, respectively) found on May 7 (Figure 3.5-1). Their occurrences in the samples was sporadic between April 16 and June 14, the last day on which smelt eggs were collected at this location. Alewife eggs were collected in day tows on June 25, our last sampling date of the season when their density was estimated to be 758/1000 m^3. In the 1979 Pickering GS 'B' preoperational study (Ontario Hydro Research Division Report No 82-266-K), the density peak of alewife eggs in the study area was found in late July.

Larval Fish

Complete larval fish data are presented in Table 3.5-2. In the Pickering 'A' intake forebay a total of 15 larvae were collected in day tows and 17 were taken in night tows. At the intake of the Scott Water Treatment Plant four larvae each were taken during the day and night tows. With the exception of a single yellow perch larvae taken in a Pickering 'A' intake forebay day tow on April 30, all larval fish were rainbow smelt. Since sampling was only conducted until June 25, alewife larvae, found to be abundant in the study area in July in 1979 (Ontario Hydro Research Division Report No 82-266-K) were not collected

In the Pickering 'A' intake forebay rainbow smelt larvae were first collected during day sampling on April 30 (Figure 3.5-1). Their density on this day was 3/1000 m^3. Highest day and night densities at this location were found on May 28 when their densities were estimated to be 775 and 679/1000 m^3, respectively. This was within the range of densities estimated for locations sampled within the study area during their peak in 1979 (Ontario Hydro Research Division Report No 82-266-K). In 1979 their maximum abundance was also found in late May (May 22). The smelt egg maximum preceeded the larval maximum by three weeks. June 11 was the last sampling date on which a smelt larvae was collected from the intake forebay. Their density on this day was estimated to be 49/1000 m^3. At the intake of the Scott Water Treatment Plant, smelt larvae were only collected on two sampling dates (May 28 and June 4) and a single sampling date during the night (May 28). During the day the density was higher on May 28 (1053/1000 m^3) than on June 4 (406/1000 m^3).

The length of the smelt larvae collected in the intake forebay and at the intake of the Scott Water Treatment Plant ranged from 5.0 to 6.0 mm, the length of newly hatched larvae is around 5.0 mm (Scott and Crossman, 1973) indicating that the larvae collected were newly hatched and that there was probably smelt spawning close to the two locations sampled.

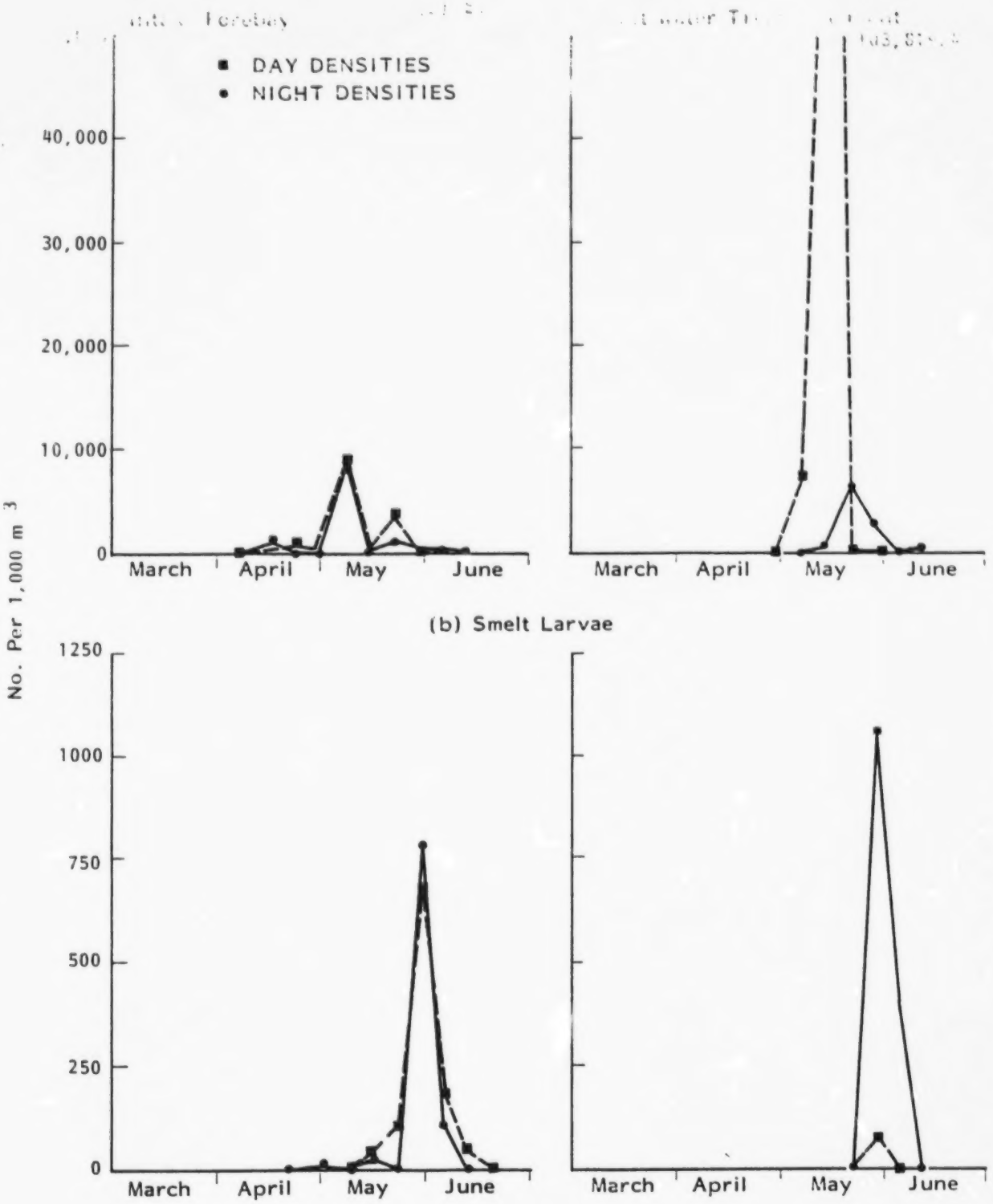


FIGURE 3.5-1

DENSITIES OF SMELT EGGS (b) SMELT LARVAE IN DAY AND NIGHT TOWS IN THE PICKERING 'A' INTAKE FOREBAY AND THE INTAKE OF THE SCOTT WATER TREATMENT PLANT. PICKERING GS 'B' PREOPERATIONAL STUDY, YEAR II, 1980

TABLE 3.5-2

NUMBERS, DENSITIES AND MEAN SIZE OF LARVAL FISH COLLECTED IN THE PICKERING 'A' INTAKE FOREBAY AND AT THE INTAKE PIPE OF THE SCOTT WATER TREATMENT PLANT - PREOPERATIONAL STUDY, YEAR II, 1980

Pickering 'A' Intake Forebay

Day Tows			Mean Size	Volume of	Density per
Date	Species	No	mm	Water Filtered (m^3)	1000 m^3
April 30, 1980	Rainbow Smelt	1	5.0	330.9	3.0
	Yellow Perch	1	7.0	330.9	3.0
May 14, 1980	Rainbow Smelt	2	6.0	70.3	28.4
May 28, 1980	Rainbow Smelt	9	5.3	11.6	775.2
June 04, 1980	Rainbow Smelt	2	5.0	19.4	103.1
Night Tows					
May 14, 1980	Rainbow Smelt	1	-	22.9	43.7
May 22, 1980	Rainbow Smelt	2	5.3	18.7	107.0
May 28, 1980	Rainbow Smelt	10	5.3	14.7	679.3
June 04, 1980	Rainbow Smelt	3	5.3	16.1	186.7
June 11, 1980	Rainbow Smelt	1	6.0	20.3	49.3

Scott Water Treatment Plant

Day Tows			Mean Size	Volume of	Density per
Date	Species	No	mm	Water Filtered (m^3)	1000 m^3
May 28, 1980	Rainbow Smelt	2	6.0	1.9	1052.6
June 04, 1980	Rainbow Smelt	2	5.0	4.9	405.7
Night Tows					
May 28, 1980	Rainbow Smelt	4	5.3	54.4	73.5

Juvenile and Adult Fish

A complete species list and the total numbers of fish collected in the study area between May and December 1980 are summarized by location in Table 3.5-3 and by gear type in Table 3.5-4. The common and scientific names of the fish are presented in Table 3.5-5. Complete data are presented in Appendix IV.

A total of 22,111 fish belonging to 44 species were collected from May through December by beach seine, trap net and gill net. Alewife was the main species caught contributing to 68% of the total catch. Other common species that made up more than 1% (>200 fish) of the total catch in order of decreasing abundance included rainbow smelt (8%), white sucker (6%), brown bullhead (5%), yellow perch (4%), white perch (2%), spottail shiner (2%) and emerald shiner (1%). The number of fish collected at the five locations ranged between 3,893 and 4,872 with lowest numbers taken at the Rouge River and largest numbers at the Pickering 'A' discharge. Totals of 4,411, 4,704, and 4,231 fish were taken at the remaining locations: Pickering 'B' discharge location, Duffin Creek and Simcoe Point, respectively.

Largest number of species were taken at Duffin Creek where 33 species were identified, followed by the Rouge River and the Pickering 'A' discharge where 32 and 31 species were taken, respectively. At the Pickering 'B' discharge and Simcoe Point, fish belonging to 28 and 25 species were caught, respectively. Alewife made up the largest portions of the fish taken at all five locations.

Beach Seine

A total of 3,478 fish belonging to 28 species were taken by beach seine. Beach seine catch was largest at the Rouge River followed by Duffin Creek. A total of 1128 fish were collected at the Rouge River and 991 fish were taken at Duffin Creek. The Pickering 'A' discharge, the Pickering 'B' discharge and Simcoe Point produced totals of 425, 385 and 549 fish, respectively. Approximately 42% of the 3478 fish collected by beach seine were alewife. Rainbow smelt was the next most abundant fish caught followed by spottail shiner and emerald shiner. These species made up 2, 10 and 7% of the beach seine catch, respectively. Small sized cyprinids and percids collected exclusively by beach seine in order of decreasing abundance were: spottail shiner, emerald shiner, longnose dace, bluntnose minnow, johnny darter, mottled sculpin, log perch, golden shiner, mimic shiner and spotfin shiner. Most of these forage fish were collected in largest numbers either at Duffin Creek or the Rouge River.

Trap Net

A total of 3,281 fish belonging to 22 species were taken by trap net. Trap net catch was highest at the Pickering 'B' discharge followed by the Rouge River and the Pickering 'A' discharge where 868, 843 and 806 fish, respectively, were caught from May

TABLE 3.5-3

Number of Fish Collected and Species Composition
of Fish Collected by Beach Seine, Trap Net and Gill Net in Lake Ontario
at Pickering GS 'B' - May-December 1980

Fish Species	Beach Seine May-November 104 Nets		Trap Net May-November 127 Nets		Gill Net May-December 148 Nets		Total	
	Total Caught	% Composition	Total Caught	% Composition	Total Caught	% Composition	Number	% Composition
Alewife	1 466	42.2	905	27.6	12 638	82.3	15 009	67.9
Rainbow Smelt	794	22.8	304	9.3	713	4.6	1 811	8.2
White Sucker	91	2.6	469	14.3	715	4.7	1 275	5.8
Brown Bullhead	4	0.1	952	29.0	97	0.6	1 053	4.8
Yellow Perch	88	2.5	433	13.2	447	2.9	968	4.4
White Perch	8	0.2	126	3.8	295	1.9	429	1.9
Spottail Shiner	330	9.5	-	-	-	-	330	1.5
Emerald Shiner	238	6.8	-	-	-	-	238	1.1
Gizzard Shad	35	1.0	2	0.1	155	1.0	192	0.9
Fathead Minnow	160	4.6	-	-	-	-	160	0.7
Round Whitefish	2	0.1	5	0.2	88	0.6	95	0.5
Longnose Dace	72	2.1	-	-	-	-	72	0.3
Brown Trout	-	-	-	-	58	0.4	58	0.3
Carp	7	0.2	20	0.6	12	0.1	39	0.2
Pumpkinseed	20	0.6	17	0.5	2	<0.1	39	0.2
White Bass	4	0.1	3	0.1	28	0.2	35	0.2
Bluntnose Minnow	33	1.0	-	-	-	-	33	0.2
Slimy Sculpin	29	0.8	-	-	2	<0.1	31	0.1
Rainbow Trout	11	0.3	1	<0.1	17	0.1	29	0.1
Smallmouth Bass	-	-	4	0.1	21	0.1	25	0.1
Splake	-	-	-	-	18	0.1	18	<0.1
Lake Chub	14	0.4	-	-	4	<0.1	18	<0.1
Yellow Pickerel	-	-	6	0.2	11	0.1	17	<0.1
Johnny Darter	17	0.5	-	-	-	-	17	<0.1
Mottled Sculpin	14	0.4	-	-	-	-	14	<0.1
Rock Bass	-	-	10	0.3	4	<0.1	14	<0.1
Log Perch	11	0.3	-	-	-	-	11	<0.1
Longnose Sucker	-	-	1	<0.1	9	0.1	10	<0.1
Common Shiner	9	0.3	1	<0.1	-	-	10	<0.1
Lake Trout	-	-	-	-	9	0.1	9	<0.1
Black Crappie	-	-	8	0.2	1	<0.1	9	<0.1
Cyprinids - unidentified	9	0.3	-	-	-	-	9	<0.1
Black Bullhead	-	-	7	0.2	-	-	7	<0.1
Golden Shiner	6	0.2	-	-	-	-	6	<0.1
American Eel	-	-	4	0.1	-	-	4	<0.1
Minic Shiner	4	0.1	-	-	-	-	4	<0.1
Lake Whitefish	-	-	-	-	3	<0.1	3	<0.1
Northern Pike	-	-	2	0.1	1	<0.1	3	<0.1
Coho Salmon	-	-	-	-	2	<0.1	2	<0.1
Lake Sturgeon	-	-	1	<0.1	-	-	1	<0.1
Spotfin Shiner	1	<0.1	-	-	-	-	1	<0.1
Stone Cat	1	<0.1	-	-	-	-	1	<0.1
Cisco	-	-	-	-	1	<0.1	1	<0.1
Catostomidae - unidentified	-	-	-	-	1	<0.1	1	<0.1
TOTAL	3 478		3 281		15 352		22 111	

TABLE 3.5-4

Total Number of Fish Collected by Beach Seine, Trap Net and Gill Net at Rouge River, the Pickering GS 'A' and 'B' Discharges, Duffin Creek and Simcoe Point from May-December 1980 Lake Ontario-Pickering GS 'B' Study Area

Fish Species	Rouge River		Pickering 'A' Discharge		Pickering 'B' Discharge		Duffin Creek		Simcoe Point		Total
	Total Caught	% Composition	Total Caught	% Composition	Total Caught	% Composition	Total Caught	% Composition	Total Caught	% Composition	
Alewife	2 222	57.1	2 996	61.5	2 930	66.4	3 486	74.1	3 373	79.8	15 009
Rainbow Smelt	326	8.4	266	5.5	421	9.5	313	6.7	485	11.5	1 811
White Sucker	199	5.1	266	5.5	463	10.5	231	4.9	116	2.7	1 275
Brown Bullhead	301	7.7	400	8.2	205	4.6	62	1.3	85	2.0	1 053
Yellow Perch	391	10.0	150	3.1	281	6.4	105	2.2	41	1.0	968
White Perch	8	0.2	392	8.0	12	0.3	13	0.3	4	0.1	429
Spottail Shiner	196	5.0	10	0.2	5	0.1	110	2.3	9	0.2	330
Emerald Shiner	145	3.7	57	1.2	10	0.2	20	0.4	6	0.1	238
Gizzard Shad	8	0.2	135	2.8	7	0.2	39	0.8	3	<0.1	192
Fathead Minnow	4	0.1	-	-	1	<0.1	155	3.3	-	-	170
Round Whitefish	3	0.1	37	0.8	17	0.4	33	0.7	3	<0.1	95
Longnose Dace	3	<0.1	1	<0.1	2	<0.1	15	0.3	51	1.2	72
Brown Trout	4	0.1	34	0.7	9	0.2	8	0.2	1	<0.1	58
Carp	3	0.1	23	0.5	3	<0.1	8	0.2	-	-	39
Pumpkinseed	6	0.2	11	0.2	2	<0.1	18	0.4	2	<0.1	39
White Bass	2	<0.1	27	0.6	4	<0.1	2	<0.1	-	-	35
Bluntnose Minnow	3	<0.1	-	-	-	-	30	0.6	-	-	33
Slimy Sculpin	1	<0.1	1	<0.1	7	0.2	2	<0.1	20	0.5	31
Rainbow Trout	6	0.2	4	<0.1	8	0.2	9	0.2	2	<0.1	29
Smallmouth Bass	4	0.1	19	0.4	1	<0.1	-	-	1	<0.1	25
Splake	3	<0.1	2	<0.1	8	0.2	2	0.0	3	<0.1	18
Lake Chub	18	0.5	-	-	-	-	-	-	-	-	18
Yellow Pickerel	-	-	14	0.3	1	<0.1	2	0.0	-	-	17
Johnny Darter	2	<0.1	1	<0.1	1	<0.1	13	0.3	-	-	17
Mottled Sculpin	1	<0.1	-	-	4	<0.1	-	-	9	0.2	14
Rock Bass	3	<0.1	6	0.1	3	<0.1	-	-	-	-	12
Log Perch	1	<0.1	1	<0.1	1	<0.1	6	0.1	2	<0.1	11
Longnose Sucker	-	-	3	<0.1	-	-	-	-	7	0.2	10
Common Shiner	7	0.2	3	<0.1	-	-	-	-	-	-	10
Lake Trout	2	<0.1	3	<0.1	-	-	2	<0.1	2	<0.1	9
Black Crappie	4	0.1	2	<0.1	1	<0.1	1	<0.1	1	<0.1	9
Cyprinids - unidentified	2	<0.1	-	-	-	-	7	0.1	-	-	9
Black Bullhead	7	0.2	-	-	-	-	-	-	-	-	7
Golden Shiner	-	-	-	-	-	-	6	0.1	-	-	6
American Eel	-	-	3	<0.1	-	-	1	<0.1	-	-	4
Mimic Shiner	4	0.1	-	-	-	-	-	-	-	-	4
Lake Whitefish	-	-	1	<0.1	-	-	1	<0.1	1	<0.1	3
Northern Pike	-	-	1	<0.1	1	<0.1	1	<0.1	-	-	3
Coho Salmon	-	-	-	-	-	-	1	<0.1	1	<0.1	2
Lake Sturgeon	-	-	-	-	-	-	-	-	1	<0.1	1
Spotfin Shiner	-	-	-	-	-	-	1	<0.1	-	-	1
Stone Cat	-	-	-	-	-	-	1	<0.1	-	-	1
Cisco	-	-	1	<0.1	-	-	-	-	-	-	1
Catostomidae - unidentified	-	-	-	-	1	<0.1	-	-	-	-	1
TOTAL	3 893		4 872		4 411		4 704		4 231		22 111

TABLE 3.5-5

Common and Scientific Names of Fish Species
Collected in Pickering GS 'B' Study Area
May to December 1980

Common Name	Scientific Name
Alewife	Alosa pseudoharengas
Brown Bullhead	Ictalurus nebulosus
Smelt	Osmerus mordax
White Sucker	Catastomus commersoni
Emerald Shiner	Notropis atherinoides
Gizzard Shad	Dorosoma cepediamon
Yellow Perch	Perca flarescens
White Perch	Morone americana
Spottail Shiner	Notropis hudsonius
Carp	Cyprinus carpio
Round Whitefish	Prosopium cylindraceum
Pumpkinseed	Lepomis gibbosus
White Bass	Morone chrysops
Longnose Dace	Rhinichthys cataractae
Smallmouth Bass	Micropterus dolomicui
Walleye	Stizostedion vitreum
Splake	Salvelinus namaycush x S. Fontinalis
Rock Bass	Ambloplites rupestris
Brown Trout	Salmo trutta
Log Perch	Percina caprodes
Rainbow Trout	Salmo gairdneri
Slimy Sculpin	Cottus cognatas
Fathead Minnow	Pimephales promelas
Lake Chub	Couesius plumbeus
Longnose Sucker	Catostomus catastomus
Lake Trout	Salvelinus namaycush
Black Crappie	Pomoxis nigromaculatus
Bluntnose Minnow	Pimephales notatus
Johnny Darter	Etheostoma nigrum
Black Bullhead	Ictalurus melas
American Eel	Anquilla rostrata
Coho Salmon	Onchorhynchus kisutch
Lake Whitefish	Coregonus clupeaformis
Northern Pike	Esox lucius
Brook Stickleback	Culeau incoustans
Common Shiner	Notropis cornutus
Trout-Perch	Percopsis omiscomaycus
Lake Sturgeon	Acipenser fulrescens
Mottled Sculpin	Cottus bairdi
Golden Shiner	Notemigonus crysoleucas
Mimic Shiner	Notropis rolucellus
Spotfin Shiner	Notropis spilopterus
Stone Cat	Noturus flavus
Cisco	Coregonus artedii

to November. A total of 222 fish were caught at Duffin Creek and 542 fish were taken at Simcoe Point. Approximately 29% of the fish were brown bullhead and about 28% were alewife. White sucker made up 14% of the catch and yellow perch and rainbow smelt contributed to 13 and 9% of the total number of fish taken, respectively. Largest number of brown bullhead were caught in trap nets set at the Pickering 'A' discharge. The largest number of alewife were collected at the Pickering 'B' discharge location. A substantially higher number of white perch were taken in the Pickering 'A' discharge than at the remaining locations. Fish taken exclusively by trap net were American eel and Lake Sturgeon.

Gill Net

A total of 15,352 fish belonging to 28 species were taken by gill net. Alewife made up 82% of the gill net catch. White sucker and rainbow smelt were the next two most common fish each comprising about 5% of the total catch. Largest numbers of fish were taken in the Pickering 'A' discharge followed by Duffin Creek. A total of 3,638 fish were taken in the Pickering 'A' discharge and 3,491 were taken at Duffin Creek. Total gill net catch at the Rouge River, the Pickering 'B' discharge location and Simcoe Point were 1,923, 3,161 and 3,140 fish respectively. Alewife and smelt were caught in largest numbers in gill nets set at Duffin Creek, white sucker in the Pickering 'A' discharge and yellow perch at the Rouge River. Substantially higher numbers of white perch and gizzard shad were taken in the Pickering 'A' discharge than at the remaining locations. Larger numbers of white perch and gizzard shad were also found in the Pickering 'A' discharge in the first year of the Pickering 'B' preoperational study conducted in 1979 indicating that these two species may be attracted to the thermal discharge. Similarly larger numbers of these two species were collected in the Pickering 'A' discharge during the Pickering 'A' postoperational study conducted from 1974 to 1976 (OHRD Report No 80-226-K). Gill net catch of brown bullhead, round whitefish, brown trout, white bass and smallmouth bass were also higher in the Pickering 'A' discharge. Brown trout, lake trout, lake whitefish, coho salmon and cisco were collected exclusively by gill net.

Alewife

As in 1979, alewife were again the most abundant fish species taken at all sampling locations contributing to 57, 62, 66, 74, and 80% of the total catch at the Rouge River, the Pickering 'A' discharge, the Pickering 'B' discharge, Duffin Creek and Simcoe Point, respectively. This species was collected from May through October by beach seine (Figure 3.5-2A), from May through November by trap net (Figure 3.5-3A) and gill net (Figure 3.5-5). In 1979 alewife were not caught after October. Graham (1957) noted that alewife move inshore in Lake Ontario in April and migrate to deeper waters in late August after spawning

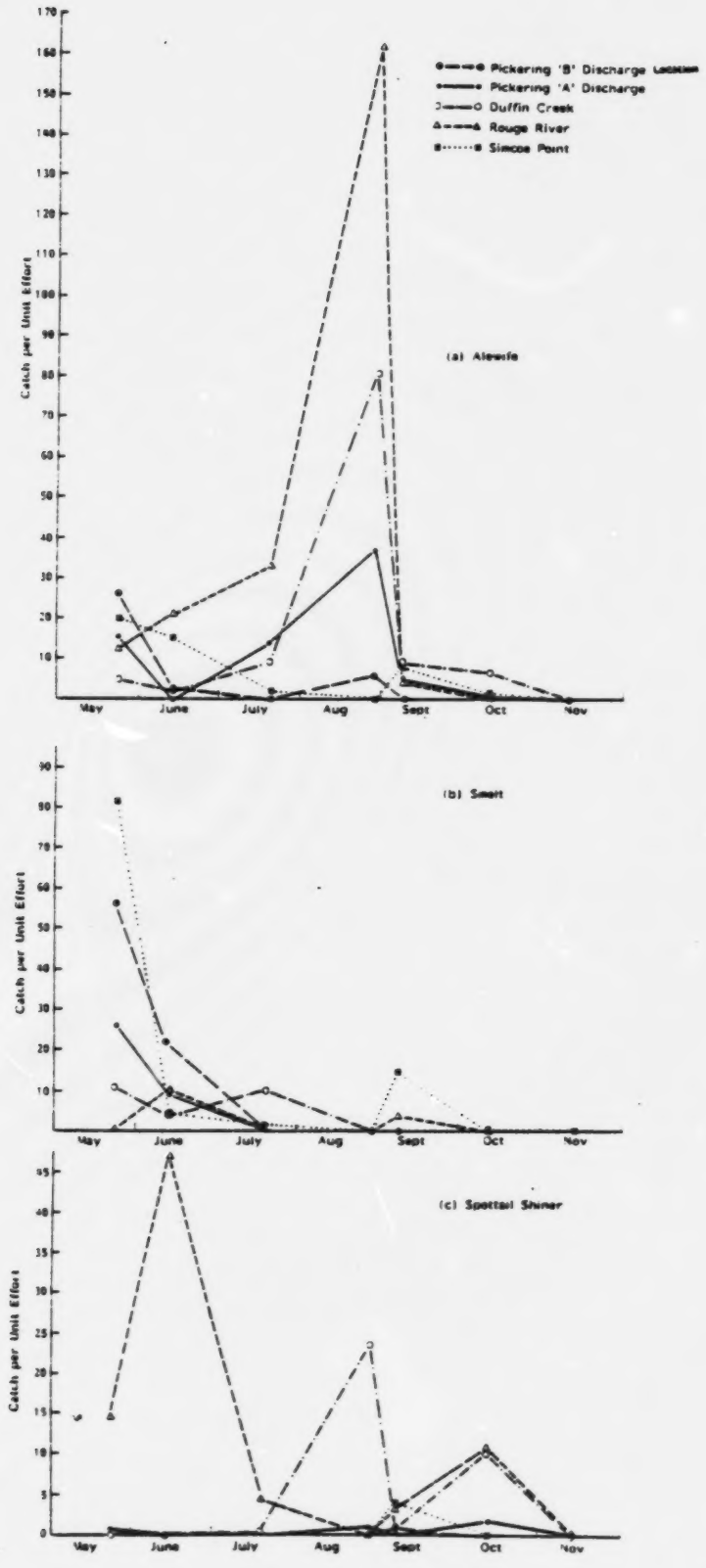


FIGURE 3.5-2

SEASONAL CATCH PER UNIT EFFORT OF (a) ALEWIFE, (b) SMELT AND (c) SPOTTAIL SHINER BY BEACH SEINE PICKERING GS 'B' PREOPERATIONAL STUDY, LAKE ONTARIO, 1980

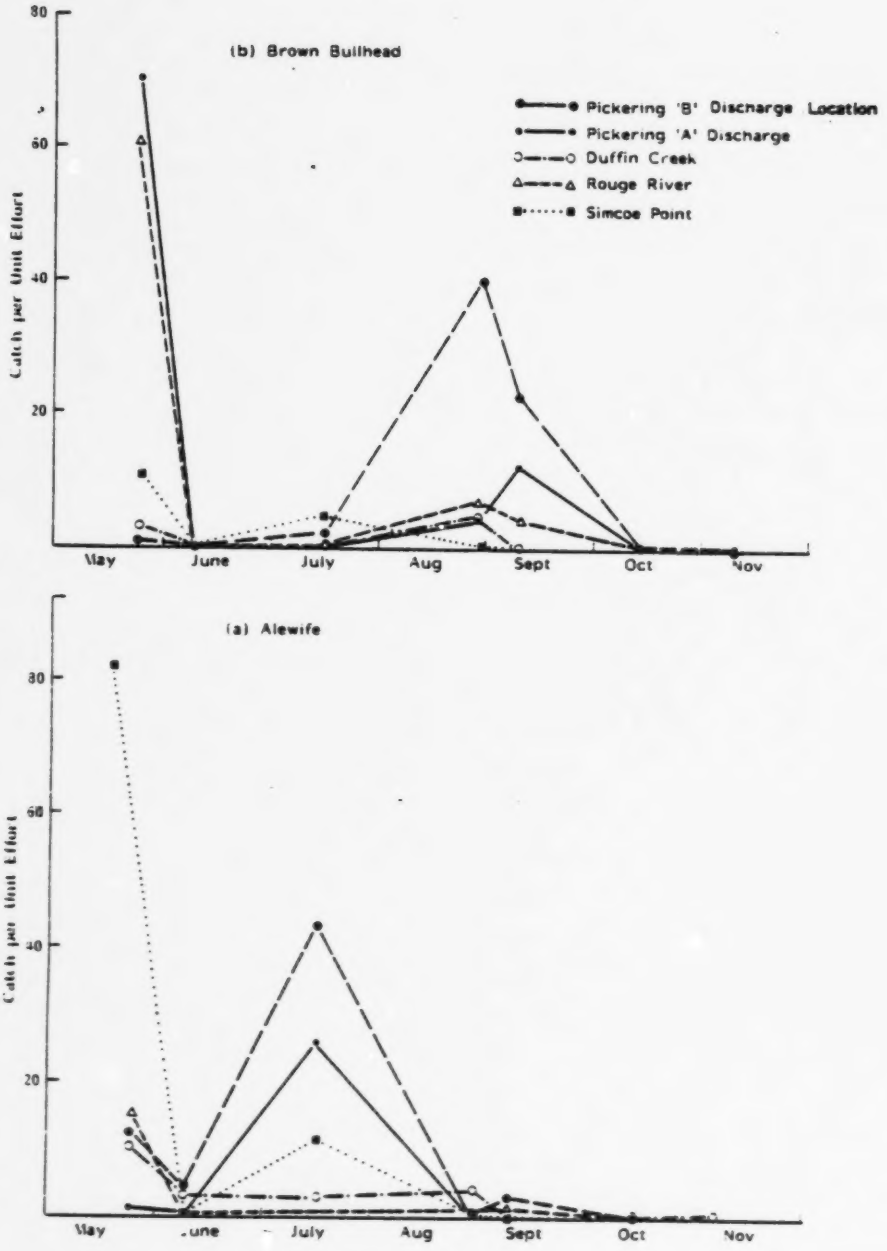


FIGURE 3.5-3

SEASONAL CATCH PER UNIT EFFORT OF
(a) ALEWIFE AND (b) BROWN BULLHEAD BY TRAP NET,
PICKERING GS 'B' PREOPERATIONAL STUDY, LAKE ONTARIO, 1980

82-460
154886 RD

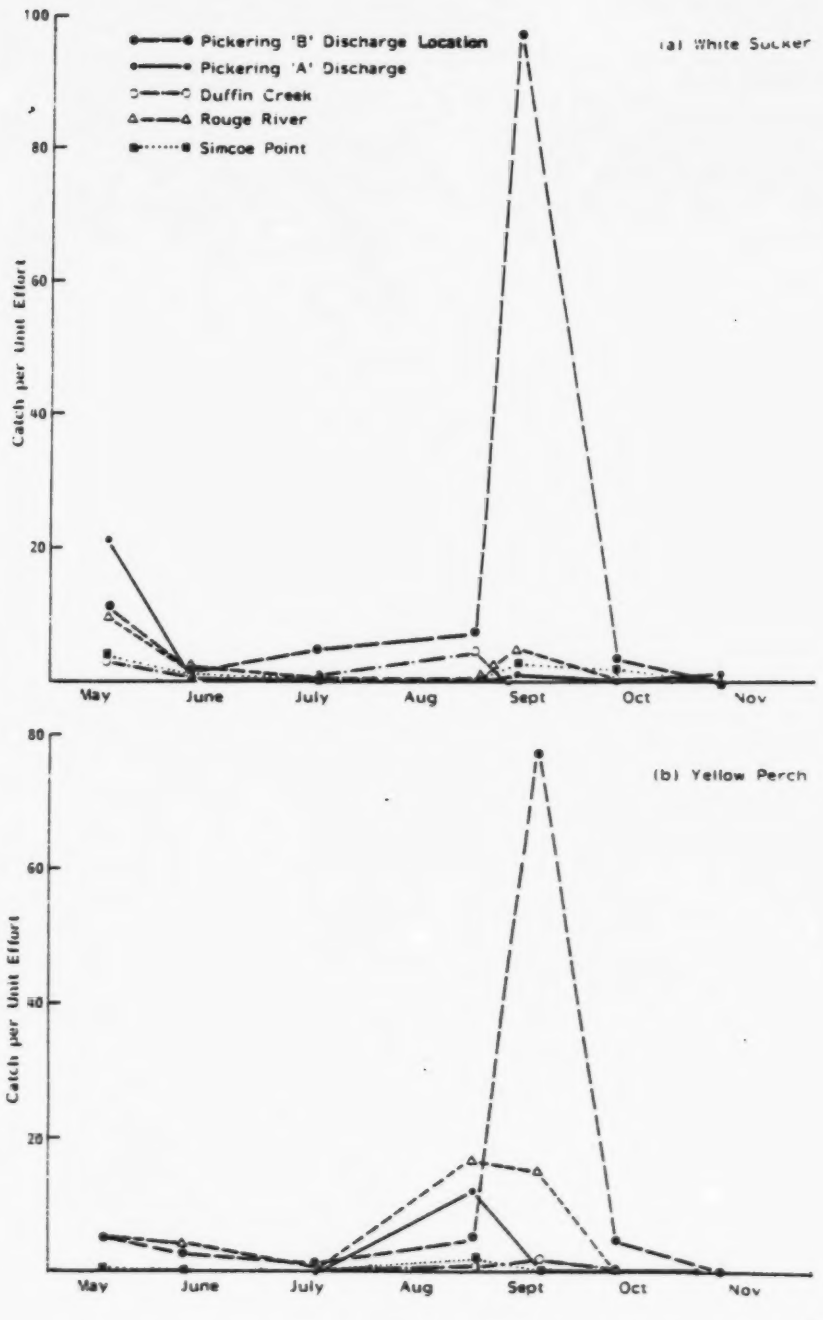


FIGURE 3.5-4

SEASONAL CATCH PER UNIT EFFORT OF
(a) WHITE SUCKER AND (b) YELLOW PERCH BY TRAP NET
PICKERING GS 'B' PREOPERATIONAL STUDY, LAKE ONTARIO, 1980

inshore. Where beach seining was conducted, alewife catch peaked in August at the Rouge River, Duffin Creek and in the Pickering 'A' discharge. At Simcoe Point and at the Pickering 'B' discharge location largest number of alewife were caught by beach seine in May. Beach seine catch of alewife were highest in August at the Rouge River when the CUE was 162. Trap net catch of alewife at Simcoe Point was highest in May when the CUE was 82. At the Pickering 'A' discharge and 'B' discharge location the alewife catch in trap nets peaked in July. Maximum CUE at the former location was 26 and at the latter it was 44. The number of alewife taken by trap nets set at Duffin Creek and at the Rouge River were comparatively low except in May when the CUE at these two locations was 12 and 16, respectively. Most of the alewife caught were taken by gill net. Gill nets set at Duffin Creek produced largest numbers of alewife in May (CUE = 387). The CUE at Simcoe Point and in the 'B' discharge were high in May and July and substantially lower in June. At Simcoe Point CUE of alewife in July was 264. At the 'B' discharge location CUE in May was 269. Only in the Pickering 'A' discharge was there an increase in alewife CUE observed in June (CUE = 257). This may indicate some movement of alewife into the 'A' discharge area at this time.

Rainbow Smelt

Rainbow smelt was the second most abundant species collected at Duffin Creek and Simcoe Point. Most of the smelt were taken by beach seine and gill net. Their occurrence inshore where beach seining was conducted was greatest in May (Figure 3.5-2B) at the time when smelt are inshore to spawn. Their numbers inshore dropped substantially after May. Beach seining conducted at Simcoe Point produced the largest numbers of smelt. CUE at this location in May was 82. With the exception of Simcoe Point smelt occurred in larger abundances in deeper waters where gill nets (Figure 3.5-6A) were set, subsequent to the spring spawning period when lower numbers were being taken by beach seines.

Smelt are pelagic fish that inhabit midwaters of lakes (Scott and Crossman, 1963). At Duffin Creek, in the 'A' discharge and at the Rouge River largest numbers of smelt were taken by gill net in June. The CUE at these locations in June were 23, 17 and 10, respectively. At Simcoe Point gill net CUE was highest in May (CUE = 14) while in the 'B' discharge largest numbers of smelt were taken by gill nets set in August (CUE = 10).

White Sucker

Most of the white suckers were taken by trap net in May at all locations except the Pickering 'B' discharge location where substantially larger numbers were collected in September (CUE = 97, Figure 3.5-4A). Gill net catch of white sucker was highest in August and September (Figure 3.5-6B). In August the CUE was highest at the Pickering 'A' discharge while in September the CUE (20) was highest at the Pickering 'B' discharge location.

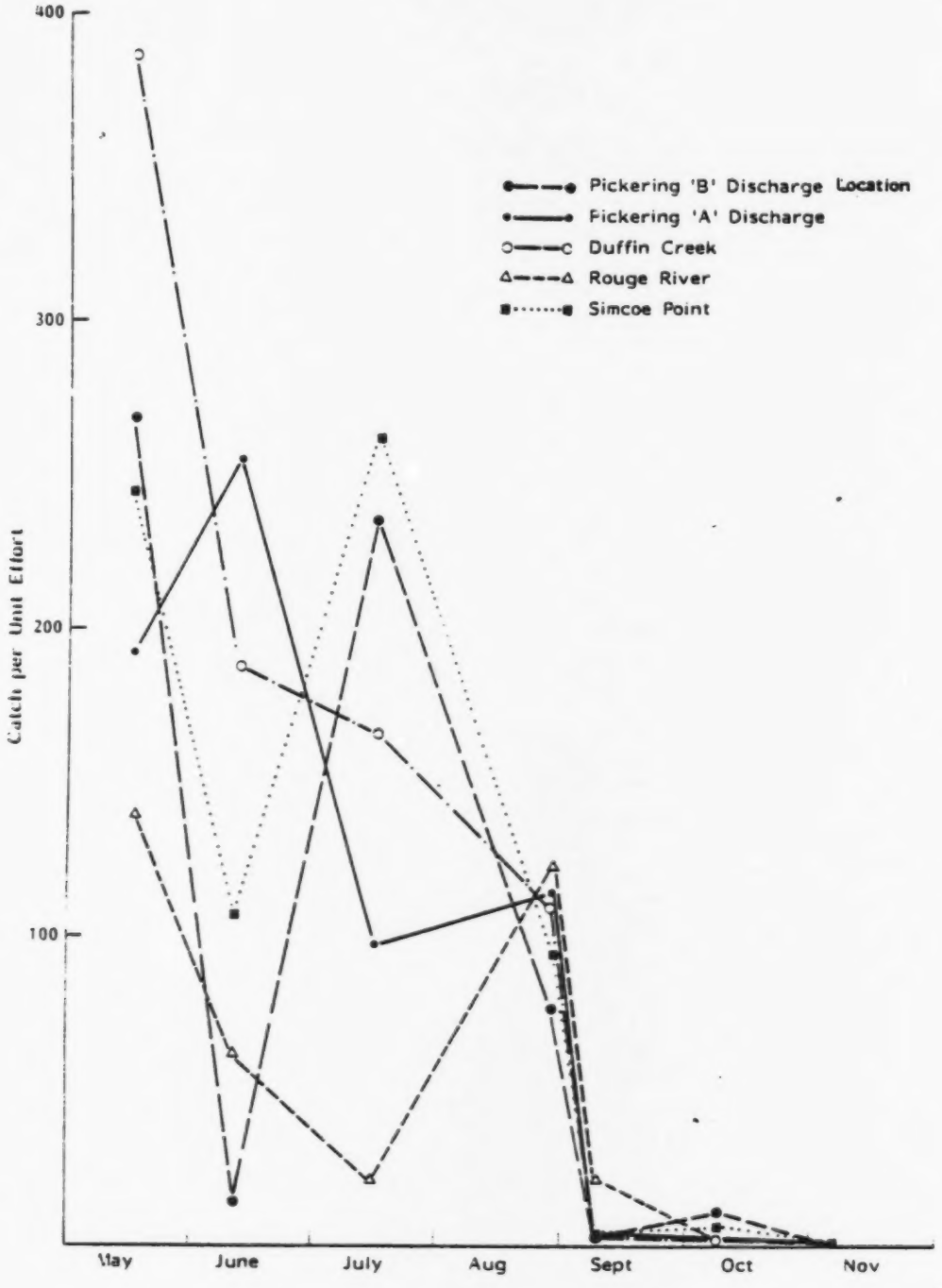


FIGURE 3.5-5

SEASONAL CATCH PER UNIT EFFORT OF ALEWIFE BY GILL NET
PICKERING GS 'B' PREOPERATIONAL STUDY, LAKE ONTARIO, 1980

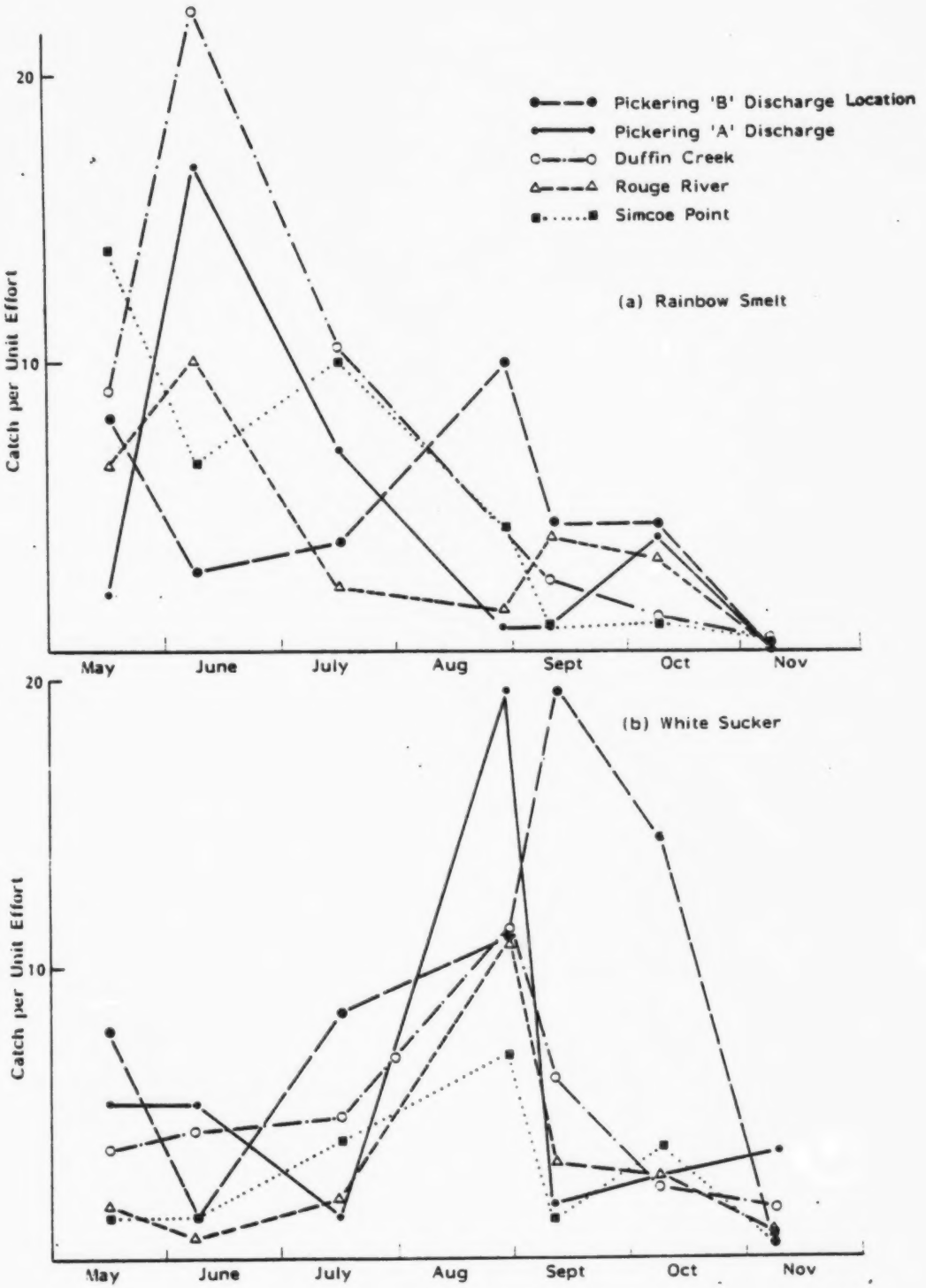


FIGURE 3.5-6

SEASONAL CATCH PER UNIT EFFORT OF
(a) RAINBOW SMELT AND (b) WHITE SUCKER BY GILL NET
PICKERING GS 'B' PREOPERATIONAL STUDY, LAKE ONTARIO, 1980

The numbers collected by trap net and gill net in May and June were probably low because the fish had moved to spawning sites. White suckers spawn in the spring usually from early May to early June and are known to spawn on lake margins or quiet areas at the mouths of streams (Scott and Crossman, 1973).

Brown Bullhead

Brown bullhead was the second most abundant fish collected in the Pickering 'A' discharge contributing to 8% of the total catch at this location. The actual numbers collected at the various locations in this year were down from 1979, especially at Duffin Creek. In 1979, approximately 1,100 brown bullhead were taken at Duffin Creek while in 1980 only 62 were caught. Brown bullhead were the most abundant fish caught during the Pickering 'A' postoperational study (OHRD Report No 80-226-K).

Brown bullhead were taken by trap net from May through November, and by gill net from May through October. Most of the brown bullhead were caught by trap net (Figure 3.5-3B). In May their CUE was highest in trap nets set at the Pickering 'A' discharge (CUE = 71) and at the mouth of the Rouge River (CUE = 61) while in August trap net CUE (39) was highest at the Pickering 'B' discharge location. Higher temperatures in the Pickering 'A' discharge may have discouraged their residency at this location in August.

Yellow Perch

Yellow perch were taken from May to November mainly by trap net (Figure 3.5-4B) and gill net (Figure 3.5-7A). Trap nets set at the Pickering 'B' discharge location in September produced by far the largest numbers of yellow perch with a CUE of 77. In September gill net catch of yellow perch was highest at the Rouge River (CUE = 19) followed by the Pickering 'B' discharge location (CUE = 17). As was the case with the white suckers they were caught in larger numbers only after their spawning season, mainly in August and September. According to Scott and Crossman (1963) spawning of yellow perch occurs in the spring from mid April to mid May but can extend into July.

Spottail Shiner

Spottail shiner were taken exclusively by beach seine and was part of the catch from May through November (Figure 3.5-2C). Largest numbers of spottail shiners were taken at the Rouge River in June (CUE = 44). According to Scott and Crossman (1963) the Canadian population of this species spawns in June or July over sandy shoals. The females caught in June were not ripe. At Duffin Creek largest numbers were taken in August (CUE = 23). This important forage fish was only taken in low numbers at the remaining locations.

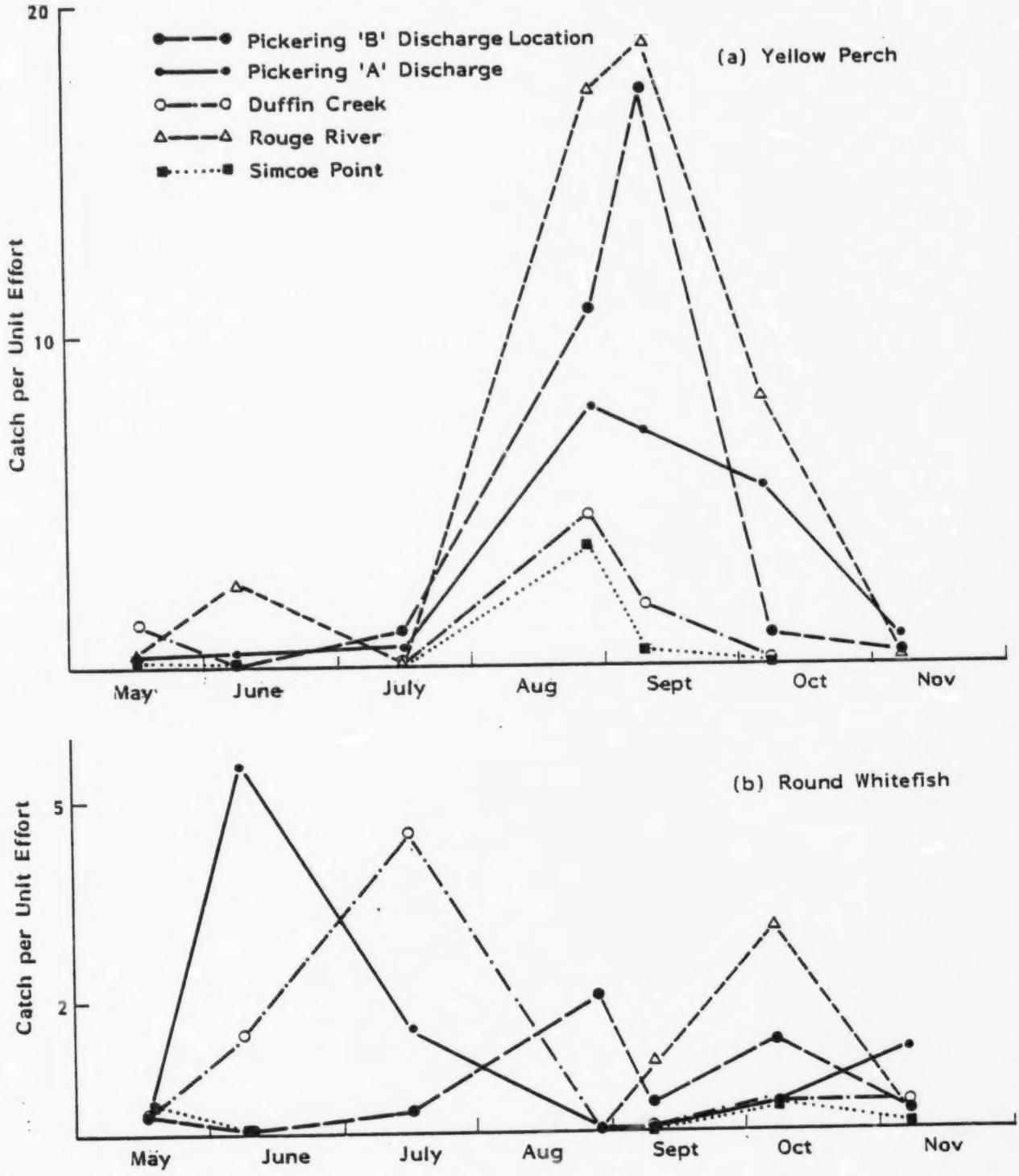


FIGURE 3.5-7

SEASONAL CATCH PER UNIT EFFORT OF (a) YELLOW PERCH AND
(b) ROUND WHITEFISH BY GILL NET
PICKERING GS 'B' PREOPERATIONAL STUDY - LAKE ONTARIO, 1980

Round Whitefish

Most of the round whitefish collected were taken by gill net. This species was part of the gill net catch from May through November (Figure 3.5-7B). Its occurrence at each location was sporadic. Maximum CUE was recorded in the Pickering 'A' discharge and was obtained in June followed by Duffin Creek where the largest numbers of round whitefish were taken in July (CUE = 5) and the Rouge River where maximum number of fish were taken in October (CUE = 3). The distribution of round whitefish in the study area during their fall spawning season as well as growth data are presented in Section 3.6.

3.6 Whitefish Survey

Distribution

Table 3.6-1 lists the catch in gill nets set during the November and December whitefish survey. Common white sucker (26%) and white perch (20%) were the most common species while round whitefish (19%) was the third most common species. Lake whitefish was the eleventh most abundant species (1%).

The catch of round and lake whitefish at each location during November and December is presented in Table 3.6-2. To make the data consistent with that presented by the Ministry of Natural Resources, catch per unit effort was calculated on a basis of 25 yds of gill net with 2.5 to 5.0 inch mesh although 11 round whitefish were caught in 2.0 inch mesh.

The most round whitefish were collected at Ross Point (78) followed by Whitby West (22) and the Pickering 'B' discharge location (2). Fewest fish were caught at the Pickering 'A' discharge. On a catch per unit effort basis, the largest catches were at Ross Point (1.1) and the Pickering 'B' discharge location (0.7).

The comparisons of catches between Ontario Hydro and Ministry of Natural Resources nets suggest that when set perpendicular to shore (Whitby West and Ross Point) MNR nets had a higher efficiency. However, when set parallel to shore there was no difference. If the results from Frenchman Bay are reliable, the differences between MNR and Ontario Hydro nets at Whitby West and Ross Point suggest that perhaps the highest concentrations of whitefish were further from shore than the end of the Ontario Hydro nets. The longer MNR nets extended 150-200 m further into the lake than did the shorter Ontario Hydro nets.

The mean catch per unit effort of round whitefish at Pickering in 1980 (0.3) is similar to catches at Darlington in 1976 (0.3), Wesleyville in 1978 (0.2) and at Pickering in 1979 (0.2) and in 1980 (0.3), but is only about 20% of the catch per unit effort at Darlington in 1977 (1.7) (Table 3.6-3).

TABLE 3.6-1

TOTAL CATCH IN GILL NETS SET NEAR
PICKERING DURING THE WHITEFISH STUDY

	NUMBER	PERCENT
Common White Sucker	205	25.9
White Perch	158	19.9
Round Whitefish	150	18.9
Brown Trout	78	9.8
Gizzard Shad	34	4.3
Yellow Perch	31	3.9
Rainbow Trout	28	3.5
Carp	28	3.5
White Bass	17	2.1
Smelt	17	2.1
Lake Whitefish	10	1.3
Northern Pike	6	0.8
Lake Trout	6	0.8
Walleye	5	0.6
Coho Salmon	5	0.6
Sea Lamprey	3	0.4
Lake Chub	3	0.4
Freshwater Drum	2	0.3
Brown Bullhead	2	0.3
Common Shiner	2	0.3
Spottail Shiner	1	0.1
Emerald Shiner	1	0.1
Mottled Sculpin	1	0.1
TOTAL	793	

TABLE 3.6-2

CATCH OF ROUND WHITEFISH, PICKERING 1980

Date	Location									
	Pickering 'A' Discharge	Pickering 'B' Discharge	Duffin's Creek	Simcoe Point	Richardson Point	Whitby West		Ross Point		Frenchman's Bay	
						Off	MNR	Off	MNR	Off	MNR
November 19	0	0	1	0	0		4	-	13	1	-
20	0	(1)	2(1)	0	0	1	-	0	-	(1)	0
25	0	(1)	0	0	1	-	1	-	22(1)	-	-
26	1	5	2	1	0	0	-	1	-	2	8
December 4	0	4(1)	2	2	1		7	2(1)	-		-
5	0	0	0	1	0	0			31		0
9	0	7	0	0	0		1	-	6	1	-
10	0	4	0	0	0		1	1			2(1)
TOTALS	1	20(3)	7(1)	4	4	1	21	6(1)	72(1)	4(1)	10(1)
						22		78(2)		14(2)	
Catch per 24 hrs*	0.0	0.7	0.2	0.1	0.1	0.1	0.3	0.3	1.3	0.3	0.3
						0.3		1.1		0.3	

() Number of Lake Whitefish
- Net Not Set
* 2.5-5.0" mesh

Temperatures at each location suggested that few round whitefish are found inshore in waters over 8°C with a catch per unit effort of 0.4 at temperatures below 8°C and a catch of less than 0.1 fish per 25 yds of gill net above 8°C (Table 3.6-4). The largest catches were recorded in waters of 2-2.5°C (CUE 1.4).

TABLE 3.6-3

COMPARISION OF ROUND WHITEFISH
SURVEYS ON THE NORTH SHORE OF LAKE ONTARIO

LOCATION	YEAR	NO CAUGHT	CUE	SOURCE
Darlington	1976	16	0.3	OHRD Report No 80-71-K
	1977	293	1.7	OHRD Report No 80-71-K
	1980	47	0.3	D. Kolenosky personal communication
Wesleyville	1978	40	0.2	OHRD Report No 82-456-K
Pickering	1979	43	0.2	
	1980	150	0.3	This Study

TABLE 3.6-4

CATCH PER UNIT EFFORT RELATIVE TO
WATER TEMPERATURE

TEMPERATURE	YARDS OF GILL NET	CATCH PER 25 YDS
2.0 - 2.5	700	1.4
3.0 - 3.5	2200	0.4
4.0 - 4.5	2000	0.4
5.0 - 5.5	600	0.4
6.0 - 6.5	1100	0.4
7.0 - 7.5	300	0.4
≥8.0	1300	0.06

Age and Growth

Scales were collected from 149 of the 150 round whitefish captured during the whitefish survey. The scales were read by both the Ministry of Natural Resources and Ontario Hydro Research Division. This process resulted in a 36% discrepancy in the age

distribution of the round whitefish as determined by the Ministry and Ontario Hydro (Table 3.6-5). The direction of the difference was not consistent. As scale readings by Ontario Hydro were confirmed by a second person, the following analysis is based on Ontario Hydro results.

The 1977 year classes, age 3+, was the most common cohort with the 1975 and 1976 year classes well represented (Figure 3.6-1). The oldest fish were 6+ and the youngest were 1+. At Darlington in 1977 round whitefish ranged from ages 4+ to 7+ with 3+ and 8+ fish caught at Darlington in 1976. The 1972 year class was the strongest cohort at Darlington in 1977. At Pickering in 1979 round whitefish ranged from 2+ to 8+. The 1977 year class being the best represented cohort while the 1975 cohort was absent. (Ontario Hydro Research Division Report No 80-371-K, Mulholland and Kolenosky 1980). In the 1980 survey the 1972 year class had disappeared and similar to the 1979 survey the 1977 year class was the best represented. The 1975 year class, however, which was absent in 1979 was well represented in 1980. In a survey conducted at Darlington in 1980 (Kolenosky pers comm) an age distribution similar to that observed at Pickering was apparent.

TABLE 3.6-5

COMPARISON OF THE AGE DISTRIBUTION OF ROUND WHITEFISH AS DETERMINED BY THE MINISTRY OF NATURAL RESOURCES AND ONTARIO HYDRO

	YEAR CLASS						% DIFFERENCE
Agency	74	75	76	77	78	79	
Ontario Hydro	9	36	24	73	6	1	
MNR	3	20	39	74	12	1	
Difference	6	16	15	1	6	0	36%

A comparision of fork-length and age is presented in Figure 3.6-2. For the most common age groups, the most common range of fork-lengths were: 3+ aged fish, 300-380 mm; 4+ aged fish, 350-460 mm; and 5+ aged fish, 400-480 mm. These results are reasonably consistent with similar data collected at Darlington in 1976 and 1977. (Ontario Hydro Research Division Report No 80-371-K).

Growth curves for round whitefish captured during this study (Figure 3.6-3) are comparable with similar curves for the other studies conducted on the north shore of Lake Ontario but substantially higher than similar curves for round whitefish from Lake Superior (Bailey 1963) and the Koksoak River, Ungava (Mackay and Power 1973).

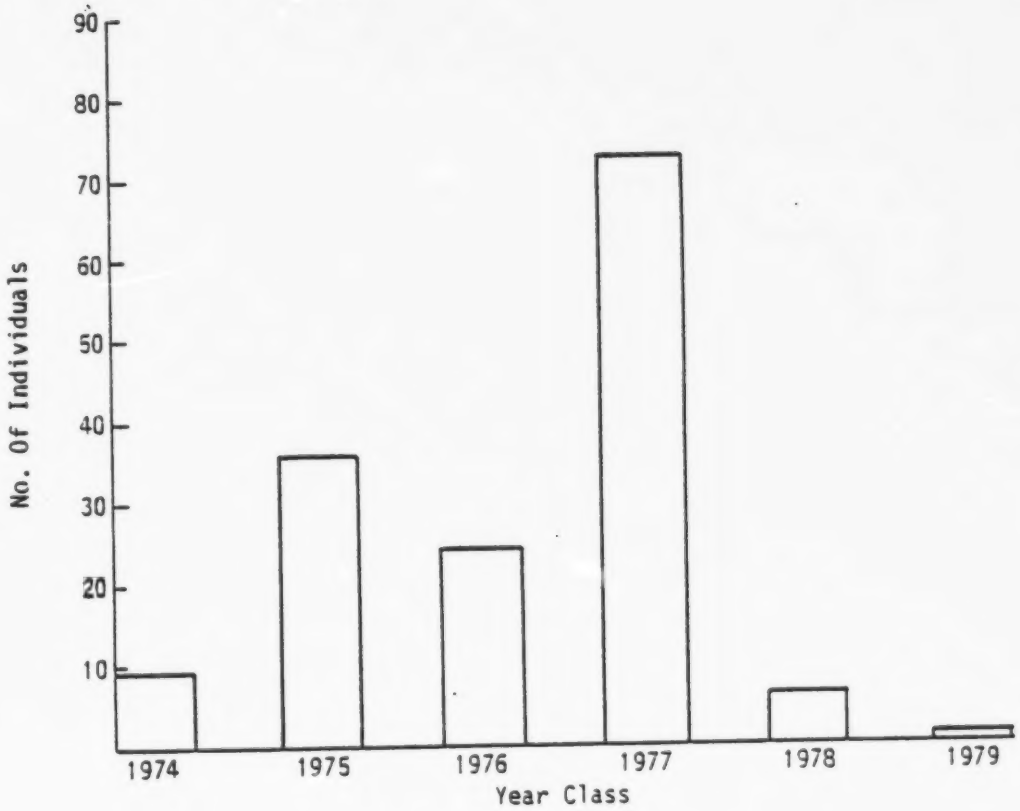


FIGURE 3.6-1

AGE FREQUENCY OF ROUND WHITEFISH
CAUGHT NEAR PICKERING NOV-DEC 1980

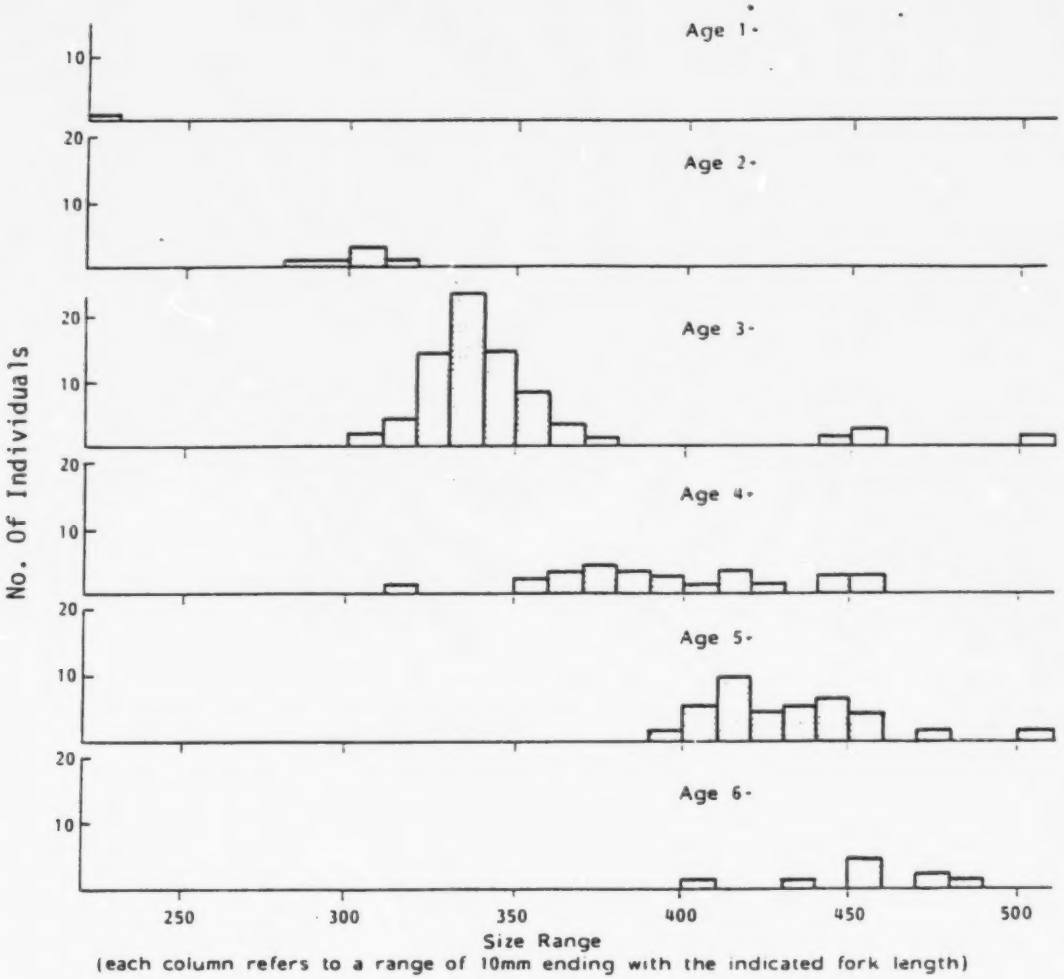


FIGURE 3.6-2

SIZE RANGE FREQUENCY OF ROUND WHITEFISH
CAUGHT NEAR PICKERING, NOV-DEC 1980

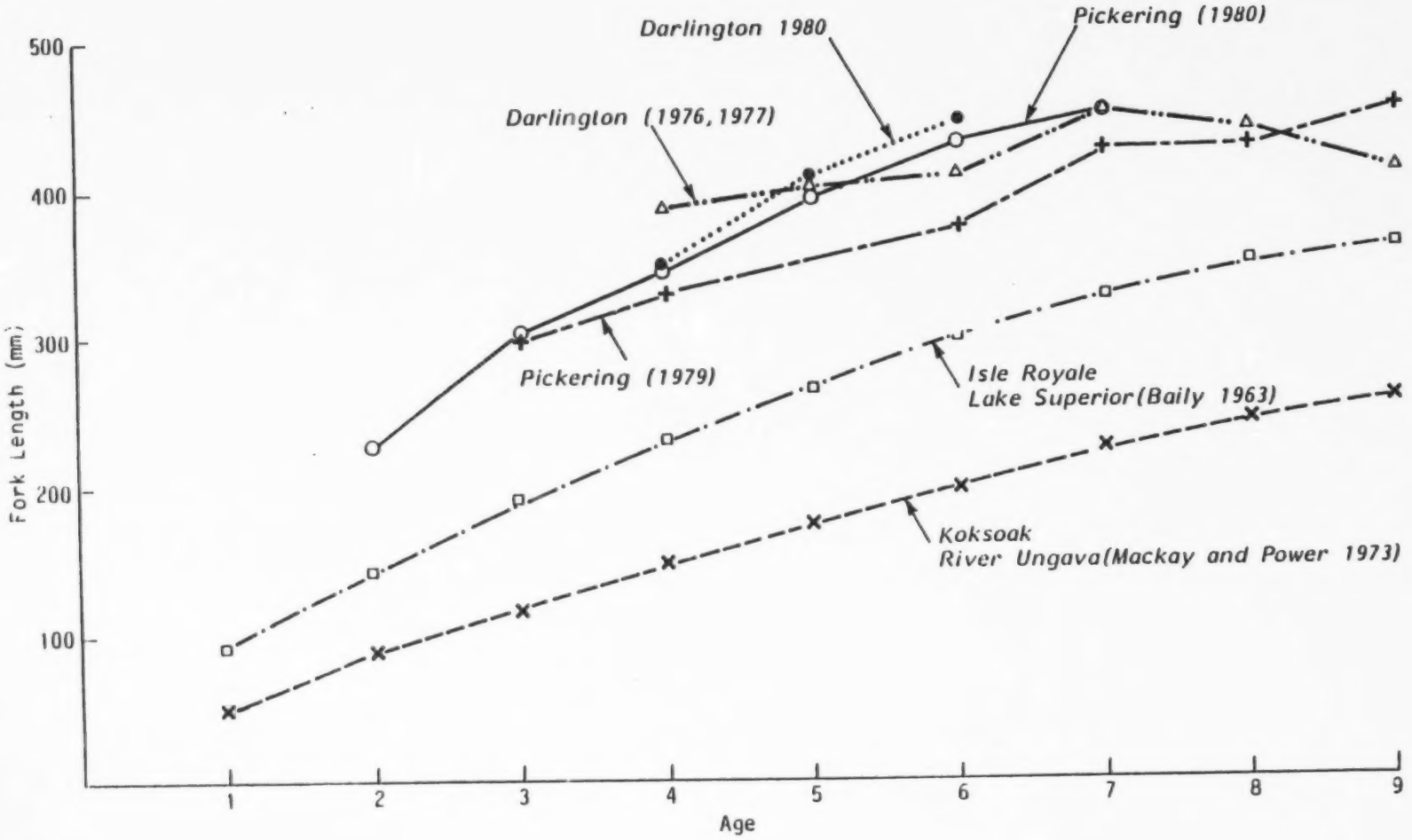


FIGURE 3.6-3

GROWTH CURVES OF ROUND WHITEFISH

15-893 RD
82-460

In the above comparisons the fork length of round whitefish caught in November and December was considered to be the same as that when the next annulies would be formed (eg, fork length at age 3+ is the same as at age 4, Mraz 1964). For example the length of a fish aged 3+ was considered to remain the same until age 4. Additionally, total length of fish in other studies was converted to fork length for comparative purposes. See Ontario Hydro Research Division Report No 80-371-K for a discussion of this conversion.

Maturity

Sex and maturity was determined on 124 of the 150 round whitefish caught during this study of these 54% were female and 46% were male. Ninety-one per cent of the fish were sexually mature and the majority of those were ripe with flowing sexual products.

A comparision of maturity and age is presented in Table 3.6-6. Ninety-four per cent of males and females over 3 years of age were mature while only 33% of males and females under three years of age were mature. Two fish (one male and one female) were mature at age 2+. Mraz (1964) found that the age at earliest maturation was also 2+ in Lake Michigan.

TABLE 3.6-6

AGE AND MATURITY OF ROUND WHITEFISH
PICKERING NOVEMBER-DECEMBER 1980

	1+	2+	3+	4+	5 +	6+	All Ages
Males							
Number	1	2	32	7	13	2	57
% Mature	0	50	100	86	100	50	91
Females							
Number	0	3	28	11	18	7	67
% Mature	-	33	86	100	100	100	91
Males and Females							
Number	1	5	60	18	31	9	124
% Mature	0	40	92	94	100	89	91

Only one spent round whitefish was found during this study. That fish was a female netted at Ross Point on December 2, 1980.

4.0 SUMMARY AND CONCLUSIONS

4.1 Physical Characteristics

During the summer collection period the amount of sediment trapped was generally higher close to shore along the 3 m depth contour and lowest along the 12 m depth contour. The organic content of the sediment trap samples was higher closer to shore than at deeper locations both during the summer and fall. The amount of sediment collected as well as the amount of organic material trapped was higher during the fall period than during the summer period. Gradual warming of the water occurred between early April and the end of July and was followed by rapid warming to the end of August when mean daily temperatures were highest. Largest degree of thermal stratification was found in late July. Major upwellings occurred in mid-August and mid-September. Secchi depth ranged from 2.0 m in July to 6.0 m in September.

4.2 Water Quality

Water quality parameters measured indicated that the water in the study area was generally good with a dissolved solids-conductivity ratio typical of waters free of industrial waste. The water was slightly basic with pH during the study period ranging from 8.1 to 8.6. Differences in the levels of water quality parameters were seasonal rather than spatial differences. Specific conductance and dissolved solids and suspended solids concentrations were lowest in September. Chemical oxygen demand and biological oxygen demand were highest in July.

4.3 Phytoplankton

The diatoms dominated the phytoplankton on both sampling dates. On May 27, *S. binderanus* was the main species present and on June 12, *M. granulata* was the main species present. The density distribution of the main taxa present on the two dates did not appear to be related to temperature.

4.4 Zooplankton

The rotifers were the most abundant group of zooplankters present on both May 27 and June 12. The cyclopoid nauplii made up the largest numbers of the crustacean zooplankters on both days. *D. bicuspidatus thomasi* adults were the only adult cyclopoid copepods and *B. longirostris* the only cladoceran present in the samples collected on both days. On May 27, during the plant outage period, the densities of some of the zooplankton taxa were found to be higher in the area south and southwest of the stations, areas frequently encompassed by the thermal plume. On June 12 the distribution of the main crustacean zooplankters were found to be quite similar to their distribution on May 27 with areas of higher abundances partially overlapping with the thermal discharge.

4.5 Fish

With the exception of a single yellow perch larva, larval fish collected in the Pickering 'A' intake forebay were exclusively smelt. Larval fish taken at the intake of the Scott Water Treatment Plant were all smelt. Highest densities of smelt larvae were found in late May - early June at both locations.

Juvenile and adult fish belonging to 44 species were collected by beach seines, trap nets and gill nets. The largest portion of fish were alewife followed by rainbow smelt. Other common fish taken included white sucker, brown bullhead, yellow perch, white perch, spottail shiner and emerald shiner. Largest numbers of fish were collected at the Pickering 'A' discharge while least were collected at the Rouge River. The substantially higher densities of white perch and gizzard shad in the Pickering 'A' discharge indicated that these species may be attracted to the thermal discharge.

4.6 Whitefish Survey

Round whitefish were collected in gill nets at all sampling locations between Frenchman's Bay and Ross Point. Highest catches per unit effort were recorded at Ross Point and at the Pickering 'B' discharge location. The catch per unit effort during this study was similar to all previous studies along the north shore but below that recorded for Darlington in 1977. No round whitefish were collected in trap nets in tributary streams.

The majority of fish were captured at water temperatures less than 8.0°C. The ages of the round whitefish collected ranged from 2+ to 6+. Almost all fish were sexually mature (>90%) and in spawning condition. Only one individual was spent, that fish being netted on December 2 when the water temperature was approximately 2°C.

As no fish were caught in the streams it appears highly probable that the round whitefish spawn in the nearshore zone of Lake Ontario

Approved:

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Biologist
Biological Research Section

JKK:lg

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APPENDIX I

ANALYTICAL TECHNIQUES USED IN THE ANALYSIS OF WATER CHEMISTRY VARIABLES
ANALYTICAL SERVICES SECTION, CHEMICAL RESEARCH DEPARTMENT, ONTARIO HYDRO RESEARCH DIVISION

ANALYTE	COLLECTION PRESERVATION	SAMPLE TREATMENT	TECHNIQUE/INSTRUMENT	REFERENCE*
pH		Bring to 25°C	Fisher Accumet Meter using Combination Electrode	Standard Methods 423
Sp Cond			Radiometer Conductivity Meter CDM3 (1 cm cell CDC304)	Standard Methods 205
Alkalinity			636 Metrohm Auto Titrator - Inflection Point Basis	OHRD 81-149
Turbidity			Hach 2100A Turbidimeter	Standard Methods 214
Diss Solids	Unfiltered LPE Bottle	filter thru 0.45 µm filter	Gravimetry	Standard Methods 209
Susp Solids			Gravimetry	Standard Methods 209
Colour				
Cl	Cool 4°C	filtered thru 0.22 µm millipore	Ion Chromatography	OHRD 81-218, 78-159
NO_3			DIONEX Model 12	
SO_4				
Total PO_4		Unfiltered	Colorimetry	Standard Methods 424
Total SiO_2			Colorimetry	OHRD No 79-124-K
TOC		Unfiltered	Beckman 900 - TOC Analyzer	Standard Methods 505
TIC			Combustion/Infrared	
Hardness	See Ca, Mg	Unfiltered	Calculation	Standard Methods 314A
NH_3	Unfiltered	filtered	Colorimetry, Automated - Technicon	Standard Methods 420A
TKN	1 mL/L H_2SO_4	Preliminary Acid Digestion and Distillation	Auto Analyzer II	OHRD 80-414
Calcium		$LaCl_3$ addition	Flame Atomic Absorption Spectrophotometry Model IL 751	OHRD 79-134-K
Magnesium				
Sodium				
Potassium				
Iron				
Manganese	Unfiltered LPE Bottle 5 mL/L Ultrex HNO_3			
Zinc				
Aluminum				
Copper		H_2O_2 addition	Atomic Absorption Spectrophotometry Model IL 951 (graphite furnace)	OHRD 82-128-K
Nickel				
Arsenic		Preliminary Acid Digestion	Hydride Formation - Flameless Atomic AbsorptionSpectrophotometry	OHRD 82-128-K
Selenium				
Mercury	Filtered thru 0.45 µm filter 5 mL/L HNO_3 + 10 µg/L Gold III		Automated Vapour Generation - Atomic Absorption Spectrophotometry	Report Pending

* NOTE: In the reference, "Standard Methods" refers to the Monograph "Standard Methods for Examination of Water and Wastewater", 15th edition, 1980, AWWA/APHA/WPCF, USA.

OHRD = Ontario Hydro Research Division report

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APPENDIX II

Mean and Standard Deviations of Phytoplankton and Zooplankton in Triplicate Samples Collected at Spar K2 (1.0 km offshore), Lake Ontario at Pickering GS 'B' on May 27 and June 12, 1980

May 27, 1980	Mean ± Standard Deviation (mgm^{-3})
Stephanodiscus binderanus	860.2 ± 174.1
Melosira granulata	517.7 ± 162.4
Cryptomonas	95.0 ± 114.6
Total Phytoplankton Biomass	1717.0 ± 388.1
Synchaeta	90712.7 ± 2318.8
Notholca laurentiae	3841.0 ± 1333.6
Notholca acuminata	5321.3 ± 211.3
Cyclopoid copepod nauplii	4812.7 ± 2088.5
Calanoid copepod nauplii	2360.0 ± 1564.7

June 12, 1980	Mean ± Standard Deviation (mgm^{-3})
Melosira granulata	156.9 ± 100.2
Cryptomonas	181.9 ± 90.5
Total Phytoplankton Biomass	624.7 ± 226.5
Synchaeta	14514.0 ± 330.8
Polyarthra	5661.0 ± 96.3
Cyclopoid copepod nauplii	191.7 ± 21.4
Diaptomus oregonensis (CVI)	88.7 ± 28.9

APPENDIX III

COMPARISON OF DENSITIES (MG M-3) AND PER CENT COMPOSITION OF PHYTOPLANKTON COLLECTED AT THE 0.5 m DEPTH WITH A VAN DORN BOTTLE AND FROM SURFACE TO 3 m WITH AN INTEGRATED TUBE ON MAY 27, 1980

Stephanodiscus binderanus, Melosira granulata and Tabellaria fenestrata were the main species present in samples collected by both gear types. Species composition and the mean relative abundances of these taxa in the Van Dorn and 3 m integrated tubes were comparable. *S. binderanus* made up 50 and 47% of the total biomass in the Van Dorn and 3 m integrated tube samples respectively. *M. granulata* constituted 32 and 31%, and *T. fenestrata* made up 6% in both sets of samples.

Two-way analysis of variance (gear type x location) performed on the data to compare the density estimates obtained for *S. binderanus, M. granulata* and *T. fenestrata* by the two sampling gears indicated no significant differences. Two-way analysis of variance on the total phytoplankton biomass estimated by the two gear types was found to be significantly different. Since the two sampling gears sampled different strata of the water column, the significant differences found in total biomass estimates is not surprising. However, since the densities of the three major taxa constituted at least 85% of the total biomass and since these density estimates were not found to be significantly different according to gear type, most of the data collected by the two gear types can be considered comparable.

Comparison of Densities (mg m^{-3}) and Per Cent Composition of Phytoplankton collected at the surface (0.5 m - Van Dorn) and surface to 3 m (Integrated Tube), on May 27, 1980, Lake Ontario at Pickering GS 'B'

	0.5 m Van Dorn		Surface - 3 m Integrated Tube	
taxa	mg m^{-3}	%	mg m^{-3}	%
Cyanophyta - Total	3.2	0.2	3.5	0.2
Anabaena sp	0.8	<0.1		
Aphanizomenon Flos-Aquae	2.1	0.2	3.5	0.2
Oscillatoria spp	0.3	<0.1		
Cholorophyta - Total	7.4	0.7	31.9	2.1
Actinastrum sp	0.2	<0.1	0.1	<0.1
Ankistrodesmus falcatus	2.0	0.2	2.3	0.2
Ankistrodesmus falcatus v. mirabilis	0.7	0.1	1.5	0.1
Cosmarium sp	0.9	0.1	24.6	1.6
Elakatothrix gelatinosa	0.2	<0.1	0.4	<1.0
Scenedesmus bijuga	3.4	0.3	3.0	0.2
Pyrrophyta - Total	33.2	2.8	54.2	3.6
Peridinium sp	33.2	2.8	54.2	3.6
Cryptophyta - Total	34.7	2.9	68.2	4.5
Cryptomonas sp	16.4	1.4	45.3	3.0
Rhodomonas minuta	18.3	1.5	22.9	1.5
Chrysophyta - Total	1.6	0.1	1.3	0.1
Dinobryon sociale	1.6	0.1	1.3	0.1
Baccillariophyta - Total	1114.9	93.3	1338.9	89.5
Asterionella gracillima	16.4	1.4	11.9	0.8
Cocconeis sp			0.4	<0.1
Cymbella	0.4	<0.1	0.3	<0.1
Diatoma	27.5	2.3	29.1	1.9
Fragilaria sp	3.1	0.3	6.6	0.4
Fragilaria Crotonensis	6.8	0.6	2.3	0.2
Gomphonema			8.1	0.5
Melosira granulata	380.8	31.9	459.2	30.7
Rhoicosphenia curvata	1.0	0.1	2.3	0.2
Stephanodiscus binderanus	603.1	50.3	701.9	47.0
Tabellaria fenestrata	65.7	5.5	94.2	6.3
Pennalis (unidentified)	10.1	0.9	22.6	1.5
Total biomass	1195.0		1498.0	

POOR

QUALITY

ORIGINAL